

CITY OF SHELTON

ANGLESIDE RESERVOIR BOOSTER PUMP STATION PROJECT

PACKAGE BOOSTER PUMP STATION

REQUEST FOR PROPOSALS

AUGUST 2013

CITY OF SHELTON
PUBLIC WORKS DEPARTMENT
525 WEST COTA
SHELTON, WASHINGTON 98584
360-426-9731

Prepared by:
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Tacoma, WA 98402
253-627-1520

CERTIFICATION

The technical material and data contained in this document were prepared under the supervision and direction of the undersigned, whose seal, as a professional engineer licensed to practice as such, is affixed below.



CITY OF SHELTON
ANGLESIDE RESERVOIR BOOSTER PUMP STATION PROJECT
PACKAGE BOOSTER PUMP STATION
REQUEST FOR PROPOSALS

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SECTION 00050

INVITATION TO SUBMIT PROPOSALS

Sealed proposals will be received by the City of Shelton Public Works Department, 525 West Cota, Shelton, WA 98584 up to 4:00 p.m. local time August 26, 2013.

The City of Shelton is planning to construct a potable water booster pump station near the current location of the Angleside Reservoir. The City of Shelton is soliciting proposals from equipment suppliers meeting the technical specifications within this request for proposals (RFP) for a booster pump station unit (package pump station) including the building structure, mechanical, and electrical equipment including a portable trailer mounted engine generator set. The City of Shelton considers this a special facility subject to RCW 39.04.280 and will evaluate proposals based on their best value to the City. Proposals received will be evaluated and scored for the purpose of selecting and negotiating a pre-purchase agreement with the highest ranking, responsive proposer. Proposals that do not meet the requirements designated within this RFP may be considered unresponsive. The equipment outlined in this RFP does not need to be manufactured by the same manufacturer, but must be supplied by the same supplier.

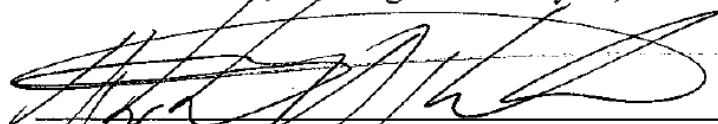
The City will score a proposal based on the scoring method summarized in these documents. Proposers are encouraged submit multiple proposals with estimated costs for different building methods.

Installation of the package booster pump station and other site construction work will be part of the Angleside Reservoir Booster Pump Station Construction Contract Documents, and will be advertised separately at a date to be determined.

Proposal documents may be obtained free of charge on the City's website, located at www.ci.shelton.wa.us as of August 1, 2013. All inquiries, about this procurement, must be in writing, and sent to publicworks@ci.shelton.wa.us

The City of Shelton reserves the right to reject any and all proposals and to waive minor irregularities in the proposal process.

Dated at Shelton, Washington this July 31, 2013.



Michael J. Michael P.E.

City Engineer

Seattle Daily Journal of Commerce: July 31, August 14, 2013

Shelton-Mason County Journal: August 1 & 15, 2013

City of Shelton Website

SECTION 00060

PROPOSAL FORM

Sealed Proposals, signed and in the original only, subject the requirements of these Contract Documents, will be received by the City of Shelton Public Works Department, 525 West Cota, Shelton, WA 98584 up to 4:00 p.m. local time August 26, 2013, for furnishing the pump station and portable trailer mounted engine generator set described in the schedule below in compliance with the terms, conditions and specifications contained herein. If you have any questions concerning this bid or the requirements, please contact the City of Shelton, Public Works Department at publicworks@ci.shelton.wa.us.

PROPOSAL ITEM	QTY	DESCRIPTION	PRICE
1.	1 ea	Packaged Booster Pump Station per specifications provided within, including delivery and startup services, installation support services, and the standard Supplier's warranty.	\$ _____
		8.6% Tax	\$ _____
		Total for Bid Item 1	\$ _____
2.	1 ea	Portable trailer mounted engine generator set per specifications provided within, including delivery and startup services, installation support services, and the standard Supplier's warranty.	\$ _____
		8.6% Tax	\$ _____
		Total for Bid Item 2	\$ _____
3.	1 ea	Optional In house 5-Year warranty on all equipment, excluding consumables.	\$ _____
		8.6% Tax	\$ _____
		Total for Optional Bid Item 3	\$ _____
		Total for Bid Items 1 and 2, and Optional Bid Item 3	\$ _____
Proposal			
In compliance with the above, the undersigned agrees, if this quotation is accepted and an agreement is reached within (60) calendar days from date of opening, to furnish any or all of the items upon which prices are offered at the price set opposite each proposal item, delivered at the Point of Destination within the time specified in Section 00100.			
Name and Address of Proposer:		Signature of Person Authorized to Sign:	
Phone No.: _____		_____	
Email: _____		_____	
Date of Bid:		Signer's Name and Title:	
_____		_____	

SECTION 00070

PROJECT INFORMATION

The City of Shelton, WA (Owner) is planning to pre-purchase a packaged booster pump station including a portable trailer mounted engine generator set referred to as the Angleside Reservoir Booster Pump Station (ARBPS) to be installed near the existing Angleside Reservoir. The packaged BPS will include all mechanical, electrical, structural, and building elements to constitute a complete pump station and portable trailer mounted engine generator set. The Angleside Reservoir is the only source of storage for the Owner's Angleside pressure-zone. Due to the elevation of the reservoir, the ARBPS is will be used to maintain pressure in the zone during periods of high demand.

The Angleside pressure-zone is currently an open zone, using storage from the Angleside Reservoir. The reservoir is supplied by the Owner's Downtown Booster Pump Station. When the new ARBPS is installed the system will act as an open zone under normal conditions and as a closed zone under high demand conditions or fire flow events. If for any reason, pressures drop below a certain minimum in the zone, the ARBPS will use a series of valves and pumps to pump water out of the Angleside reservoir and maintain pressure to the system at or above the minimum set point and below the open-zone maximum set point.

The pump station must be capable of providing low flows as well as flows up to 1,500 gpm with three pumps at full speed. To accomplish this, all pump motors will use variable frequency drives. A combination pressure sustaining valve and pressure reducing valve will control flow into the system while protecting the pumps. A pressure sustaining valve on the discharge side of the pumps will relieve excess pressure in the station from the pumps back into the reservoir if needed. A pressure sustaining valve on the reservoir inlet will maintain system pressures while allowing any excess water from the ARBPS or Downtown Booster Pump Station to also fill the reservoir.

The following technical specifications outline the product and manufacturing requirements of the package booster pump station. The package booster pump station is anticipated to include, but not be limited by the content of Section 11191 – Packaged Booster Pump Stations. A pump station schematic for reference is provided as Appendix A. This schematic is provided for guidance only and it is anticipated that pump station manufacturers' designs may vary. Any variations from the schematic must keep in line with the overall performance goals of the project.

SECTION 00100

INSTRUCTIONS

1. EQUIPMENT SUPPLIER EVALUATION PROCESS

The City of Shelton (OWNER) is requesting proposals to supply a pre-manufactured potable water booster pumping station including a trailer mounted portable engine generator set for the Angleside Reservoir Booster Pump Station (ARBPS) Project scheduled to advertise for construction bids in 2013. It is the desire of the City to pre-purchase the pumping station and portable engine generator set and have the construction contractor coordinate with the pump station manufacturer to install the station after it is fabricated.

Within the context of this Request for Proposals (RFP) the term "SUPPLIER" shall be construed to mean the supplier proposing to provide the packaged water pumping station manufactured of in-house or obtained equipment. The "MANUFACTURER" shall be construed to mean the pump station manufacturer contracted by the SUPPLIER or the SUPPLIER's in house manufacturing department. The terms "SUPPLIER" and "MANUFACTURER" are used interchangeably throughout this document. Murray, Smith & Associates, Inc. (herein after called "ENGINEER") is preparing plans and specifications for construction of the ARBPS.

Pre-purchased equipment proposals will be evaluated based on the instructions and criteria contained within this section and the technical specifications that follow. Proposals shall be submitted for a complete, packaged water pumping station. The system SUPPLIER will be expected to provide design assistance to the ENGINEER and OWNER and review of the construction contract plans and specifications prior to advertisement as well as provide construction support to the OWNER, construction contractor, and ENGINEER during site-work construction and pump station startup.

Proposals are for equipment, services, and materials related to the construction of the packaged water pumping station and do not include labor for installation of the station at the site. Installation of the station shall be provided by a licensed general contractor, selected by and contracted to the OWNER under a separate contract.

Proposal prices shall include freight and other normal handling charges required to deliver the station to the ARBPS construction site located at generally the intersection of S 15th Street and W Harvard Ave in Shelton, WA and unload the station. The ARBPS construction site will be the Point of Destination. Proposals shall also include an estimate of MANUFACTURER's lead time. The OWNER shall use this time in order to provide the system SUPPLIER with an assembly start date. The SUPPLIER will coordinate delivery with the Construction Contractor to be selected by the OWNER for the on-site work. Prices shall also include the cost of providing a MANUFACTURER's service representative as specified herein including meals, travel, lodging, and all related costs and expenses for required training, testing, start-up, and installation verification.

Submittal of this proposal to the City does not obligate the OWNER to advertise the construction contract documents, select a general contractor, construct the project, or purchase the station.

2. PROPOSALS

Proposals submitted to the City shall be in printed form (provide three complete copies) and electronic form (provide six copies) and shall be titled "Angleside Reservoir Booster Pump Station Proposal."

3. PROPOSAL PRICES

The proposal price shall include a cost for equipment (and services) including, but not limited to: furnishing, delivering to job site and unloading all materials, equipment, tools, supplies, spare parts and all design assistance, management, labor, and services, for a complete and optimized operational facility. Prices for equipment and services provided in the proposal shall be valid for a period of sixty (60) days from the proposal opening date. The City of Shelton will negotiate a pre-purchase agreement with the selected package booster pump station supplier based upon this proposal. The pre-purchase agreement will include but will not be limited to:

- Limiting modifications to the pump station drawings between design phase and actual construction.
- Price escalation allowed between expiration of this proposal and the actual construction.
- Coordinating delivery and installation with the City's Construction Contractor.

The City also reserves the right to negotiate a pre-purchase agreement with the second or third ranked supplier (respectively) if unable to reach an agreement with the preferred package pump station MANUFACTURER.

4. CONTENT OF PROPOSAL

In order to maintain fairness and integrity in the selection process, it is important that proposals conform to the requirements of this section. Divide proposal into sections as described below using divider tabs and provide the information in the order requested.

Section 1

- a. Provide the name, address, email or website, and telephone number of your company.
- b. Provide the name and email address of your lead person or project manager.

- c. Provide the name, address, website, and telephone number of the corporate home of the MANUFACTURER and of the factory where the equipment will be manufactured.
- d. Provide the name, address and telephone number of the nearest factory authorized service center for the equipment MANUFACTURER and the number of years this relationship has existed.
- e. Provide a statement that your proposal price(s) will be valid for negotiating a pre-purchase agreement for a period of sixty (60) days following the proposal opening date.
- f. Provide the signature of the responsible supplier certifying the entire proposal document.

Section 2

Provide the names and project details of at least three (3) customers who have installed equipment similar to that proposed herein. Packaged buildings should be of similar type, size, and construction methods. Preference is given to those SUPPLIERS and equipment MANUFACTURERS who have experience with the size of equipment specified herein.

Said customers must be the end owners of said equipment. Preference is given to sales made during the last three (3) years. For each customer, describe the equipment components supplied and provide the name, email address, and telephone number of the customer's project manager.

Section 3

Provide model number and descriptive literature addressing:

- a. Preliminary pump station and equipment layout.
- b. Equipment List and drawings of similar sized/capacity pump station, installation and structural requirements, including access requirements for maintenance and equipment removal. Drawings shall be project specific, 22" X 34" size, fully to scale and properly dimensioned and annotated showing the proposed station in at least three (3) views as Full Plan View, Lengthwise Section View, Sidewise Section View and any details needed to properly describe the station. All piping, fittings, valves, strainers, meters, control valves, air valves and related components shall be shown.
- c. A sequentially numbered, mechanical Bill of Materials with model numbers and manufacturers listed.
- d. Complete catalog data with specifications and identification of materials of construction.

- e. Equipment supplier's general fabrication, specific materials used in each piece of equipment, assembly and installation drawings, schematics and specifications for a similar size/capacity station.
- f. Physical size, capacity and configuration of equipment, including location of electrical and mechanical connection points.
- g. Performance curves for proposed pumps expressed in gallons per minute of flow and feet of head that also includes net positive suction head required and pump efficiencies at the various flow rates.
- h. Physical size, weight, and configuration of component parts in which the equipment will be shipped.
- i. Weight of the equipment and the general location of the required supports.
- j. Manufacturer equipment proposal performance, equipment efficiency, total energy consumption for operation at design capacity.
- k. Complete list of all electrical equipment and monitoring equipment with power service requirements and pertinent information; total connected power and total maximum operating power requirement for pumping system.
- l. Description of the equipment controls.
- m. Description of the routine operation and maintenance tasks, their frequency and required consumable materials or equipment for those operations.
- n. Locations at which a complete stock of spare parts are maintained.
- o. Locations from which service people fully qualified to maintain this equipment are available.
- p. Complete control panel and wiring diagrams (all electrical equipment shall be UL listed and labeled or equivalent laboratory recognized by the Washington Department of Labor and Industries), electrical system drawings and description including but not limited to:
 - i. Complete system interconnection diagrams between power supply, control panels, pump motors, and all ancillary equipment connected to control system, including terminal number connection points for the system.
 - ii. Complete electrical schematics with power wiring and control wiring in accordance with current standards; schematics shall include all component ratings.
 - iii. Description of control system in written form including functions monitored, controlled, and alarmed. Include sequence of operation and interface requirements.
 - iv. Control component itemized information and data. Control panel(s) front face layout and internal component block diagram.
 - v. Location, size and quantity of conduit entrances into the station.
 - vi. Process and instrumentation Diagrams in the proper ISA convention.

- vii. A complete electrical power three-line/one-line drawing identifying the designation, size and rating of all the power electrical components.
- viii. A sequentially numbered electrical component Bill of Materials with model numbers and manufacturers listed.
- ix. A sequentially numbered instrumentation device Bill of Materials with model numbers, manufacturers and input signal designation.
- q. Load and sizing calculations for portable trailer mounted engine generator set.
- r. Names and years of experience for electrical engineers, field technicians and control system engineers as required by Section 17010.
- s. Operation and maintenance and installation manuals from a similar size and type pump station. This shall include a list of all software licenses, program discs, including operating system.
- t. If pump station SUPPLIER believes that the equipment duty points specified in this pre-purchase document do not provide optimum performance and/or cost reduced operation, they need to provide a description of their recommended duty points and how this improves operation and/or O&M cost. The OWNER will review this after pre-selection.
- u. Warranty information to include length, conditions, and statement of no cost to buyer for all basic warranted items.
- v. Name of manufacturer authorized service support and service office locations.
- w. Manufacturer's electrical control panel U.L file number.
- x. Manufacturer's complete pump station U.L. file number.

If the chosen equipment differs from the layout or specifications included in this request for proposal, these changes must be disclosed in this section.

SUPPLIERS are encouraged to provide a narrative that describes optimal control sequencing of the proposed equipment to accommodate the expected equipment use.

Please note: SUPPLIERS are allowed to submit additional proposals that feature different makes or models of equipment.

Appendix

1. Attach any extra information required under Section 3 above.
2. If there are any requirements or provisions contained in this Request for Proposals that you believe are unfair or prejudicial or limit competition, please explain your position.

5. EVALUATION CRITERIA

OWNER intends to pre-purchase a packaged booster pump station including portable trailer mounted engine generator set from the proposals submitted. Proposals shall be carefully evaluated based on the information provided. A selection committee will analyze the proposals and may ask for additional clarification. The committee will then score the proposals in accordance with the evaluation criteria provided in the table below. The highest scoring, responsive and responsible proposal will be eligible for the award of the purchase contract, contingent upon meeting the qualifications set forth in these contract documents and negotiating a purchase agreement with the OWNER.

Category	Criterion	Maximum
Equipment Performance	How well does proposed equipment meet the OWNER's requirements? How far does the proposed equipment exceed the OWNER's requirements? What is the quality and capacity of the proposed equipment?	15 Points. Any SUPPLIER failing to provide the minimum requirements will be disqualified. SUPPLIERS exceeding the minimum by the greatest margin will be awarded the full score and others pro-rated from that.
Building Structure	What is the quality of the building structure? How complete is the building upon arrival? What are the delivery and unloading requirements of the building? What are the maintenance requirements of the building?	15 Points. The building with the highest quality and ease of use will receive the full score. Other scores will be pro-rated from that score.
Operation and maintenance (O&M) requirements	Replacement parts, cost and availability to receive parts for the ARBPS. Recommended maintenance plan. Proximity of SUPPLIER's service representative and individual equipments' authorized service personnel to Shelton, WA.	15 Points. The proposal with the most favorable O&M requirements will be awarded with the highest quality and ease of use will receive the full score. Other scores will be pro-rated from that score.
References	Three (3) similar installations and contact information for each. The OWNER will contact each reference and generate a score based on recorded experience with the equipment. Installations must incorporate the same type of modular building and similar equipment.	15 Points. At a minimum, the OWNER will ask references about performance, service response, parts availability, ease of equipment operation, roof, and building quality.
Cost	Initial and life-cycle cost. Life-cycle cost will be calculated for a 20-year time period. Life cycle cost will address power and consumables costs (if any) between proposals.	25 Points. Lowest combined initial and life cycle cost will be awarded the full score and others will be pro-rated from that cost.
Warranty	Length of standard warranty on building, roof, and all equipment. Minimum warranty required is one (1) year on equipment and twenty (20) years on the building and roof structure.	10 Points. Longest warranty will be awarded the full score, those at or below the minimum will be awarded 0.
Estimated Lead Time	Will the SUPPLIER's estimated lead time meet the project requirements?	5 points.

6. ALTERNATIVE MANUFACTURERS

The specifications and drawings developed for this request for proposals are meant to serve as a basis for evaluating proposals. It is understood that manufacturers design and produce their products in different manners. Minor specification variances between manufacturers are expected. Minor variances from the technical specifications will be considered provided that they keep with the intent of the specifications and the performance requirements are satisfied. The City reserves the right to accept or reject any proposed variance.

7. RFP NOT BASIS FOR OBLIGATIONS

This RFP does not constitute an offer to contract and does not commit the City to the award of a contract, or to pay any costs incurred in the preparation and submission of proposals. The City reserves the right to reject any or all proposals. The City also reserves the right to cancel all or part of this RFP for any reason determined by the City to be in the public interest.

8. PURCHASE CONTRACT

Upon selection of the proposal, the OWNER and SUPPLIER will negotiate a purchase agreement for furnishing the packaged booster pump station. The agreement will finalize reference and append these RFP documents, and add the contract terms and conditions. The OWNER reserves the right to negotiate a pre-purchase agreement with the lower ranking proposers if an acceptable agreement cannot be reached with the selected proposer. Grounds for terminating an agreement may include an effort by the SUPPLIER to change cost, service, or quality from the proposal, or notification of disbarment.

The pre-purchase agreement payment schedule will conform to the following:

Date	Description	Percentage of Total Contract to be Paid
Pre-Purchase Agreement Signing	Amount due to the SUPPLIER once the Contract is signed.	10
Notice To Proceed / Submittal Approval	Amount to be paid once all pre-construction coordination is finalized with the ENGINEER, OWNER, and Construction Contractor when submittals are approved and given the Notice to Proceed with manufacturing.	40
Delivery	Amount due to the SUPPLIER at the time of delivery to the Point of Destination. ¹	40
Pump Station Start-Up	Amount due to the SUPPLIER once all Construction Support, Start-Up, OWNER staff training, and all other SUPPLIER obligations are complete.	10

¹ If the progress of the project is delayed for any reason by the OWNER or Construction Contractor requiring the SUPPLIER to delay shipment of the packaged system, this amount will be paid within 30 days after the time of “Fabrication Completion.”

COMMUNICATIONS PROCEDURES

The requirements of this section are intended to ensure the fair and equal treatment of all proposing suppliers. The City will respond to questions concerning the preparation of proposals. All questions about the meaning or intent of the Proposal Documents are to be directed to the City Public Works Department at 360-432-5104 or publicworks@ci.shelton.wa.us.

9. COMPLAINT/DISCREPANCY PROCESS AND ADDENDUM PROCEDURES

If discrepancies or omissions are found or there is doubt as to the true meaning of any part of this RFP, a written request for clarification or interpretation shall be submitted to the City Public Works Department. No oral interpretations shall be effective to modify any of the provisions of the RFP. Every request for an interpretation shall be made in writing and addressed to the City Public Works Department and, to be given consideration, must be received at least 7 (seven) calendar days prior to the date set for the opening of proposals. Any and all such interpretations will be provided via addendum and posted to the BXWA and City of Shelton websites. It is the Proposer’s responsibility to watch for and acknowledge all addendums in the official proposal for or be deemed non-responsive.

Interpretations will be posted as outlined above no later than four (4) calendar days prior to the date fixed for the opening of proposals. Failure of any Proposer to receive or review any such addendum or interpretation shall not relieve such Proposer from any obligation under this Request for Proposals.

10. THIRD-PARTY INSPECTION LISTING

The station MANUFACTURER shall be required to affix to the station an UNDERWRITERS LABORATORIES (UL) LABEL attesting to the compliance of the station equipment under the PACKAGED PUMPING SYSTEMS (QCZJ) UL Listing Category and/or INTERTEK TESTING SERVICES (ETL) LABEL attesting to the compliance of the station equipment under PACKAGED PUMPING SYSTEMS. If used, the ETL label shall state the station conforms to UL STD 778 and is certified to CAN/CSA STD C22.2 NO. 108.

11. PERFORMANCE GUARANTEE AND WARRANTY

The system SUPPLIER shall warrant the packaged pumping station to be of quality construction, free from defects in material and factory workmanship. The warranty is the full responsibility of the station MANUFACTURER/SUPPLIER. Any warranty conditions will be dealt with using SUPPLIER service personnel. Equipment manufacturers’ service

personnel trained and authorized to work on equipment furnished by the SUPPLIER may work on equipment provided they are coordinated and supervised by the system SUPPLIER. The warranty period shall commence upon the final written acceptance by the OWNER to the system SUPPLIER and shall be subject to Section 1-05.12 of the 2012 WSDOT Standard Specifications and the following minimum requirements.

- A. The pump station structure shall be warranted for a period of twenty (20) years to be free from defects, corrosion, roof leaks, masonry cracks, or physical failures occurring in normal service, when installed in accordance with the MANUFACTURER's recommendations.
- B. The interior equipment, pumps, motors, and apparatus shall be warranted for a period of one (1) year, excepting only those items normally consumed in service such as oil, grease, gaskets, or O-rings.
- C. The SUPPLIER has warranty responsibility for all components, devices, and sub-systems within the station, being so responsible regardless of the component manufacturer's warranty on any particular part.
- D. Major components which fail to perform as specified by the ENGINEER or prove defective in service during the warranty period shall be replaced, repaired, or satisfactorily modified by the system SUPPLIER without cost of parts or labor to the OWNER. After start-up service has been performed, labor to replace accessory items such as heaters, valves, or other accessible and easily serviced parts shall be the responsibility of the OWNER. Such components, parts, or repairs determined to have failed because of defects in workmanship or materials will be replaced or repaired F.O.B. at the factory or other designated location.
- E. Should the station MANUFACTURER fail to replace or repair a defective component in a timely and satisfactory manner, the OWNER has the right to repair or replace the defective part and bill the MANUFACTURER for the cost of this defect resolution.
- F. No assumption of contingent liabilities for any component failure is to be made by the system SUPPLIER.
- G. At the discretion of the OWNER, the OWNER and its designated agent(s) shall be allowed access to the MANUFACTURER's shop premises to view the equipment in-process or as a finished fabrication, or both.
- H. The MANUFACTURER shall have instituted a formal Quality Assurance (QA) program. The OWNER may require submission of the QA records pertaining to the equipment fabricated for them.
- I. The design and fabrication of the station shall be at a level of quality that meets and exceeds City standards, written or inferred, and assures a long, useful service life.

SECTION 01300

SUBMITTALS

PART 1 GENERAL

1.1 Submittals

The SUPPLIER must submit to that ENGINEER any corrections to the proposal or submittal package the MANUFACTURER wishes to make throughout the duration of the project. The Owner reserves the right to refuse any products used in the manufacturing of the pump station that were not listed in the proposal or submittal packages or not accepted by the ENGINEER. Costs associated with the work required to remedy the discrepancy will be the sole responsibility of the SUPPLIER.

The SUPPLIER shall provide submittals including shop drawings, schedules, drawings, and such other information as may be necessary for the prosecution of the work in the shop as required by the contract documents or the ENGINEER's instruction. There may be other submittals required elsewhere in these Specifications that are not necessarily included or mentioned in this Section.

Within fourteen (14) days after award of the contract, the SUPPLIER shall submit to the ENGINEER a proposed list of manufacturers, suppliers, and sub-suppliers and a schedule of specific target dates for the submission and return of shop drawings required by the contract documents. The list and schedule shall be updated and re-submitted when requested by the ENGINEER. All shop drawings for interrelated items shall be scheduled for submission at the same time. Not less than one (1) week shall be allocated to each submittal for processing by the ENGINEER.

The ENGINEER will review shop drawings to determine compliance with the design concept of the project and return them to the SUPPLIER within the period established in the shop drawings schedule. The ENGINEER may hold shop drawings in cases where partial submission cannot be reviewed until the complete submission has been received or where shop drawings cannot be reviewed until correlated items affected by them have been received. When such shop drawings are held, the ENGINEER will advise the SUPPLIER in writing that the shop drawing submitted will not be reviewed until shop drawings for all related items have been received.

The ENGINEER will review the submitted data and shop drawings, and will make notations thereon indicating "No Exception Taken", "Make Corrections Noted", "Rejected", "Revise and Resubmit", or "Submit Specified Item". The ENGINEER will then return two copies of the submitted data and shop drawings to the SUPPLIER. The ENGINEER's review of submittals and shop drawings is not a check of any dimension or quantity, and will not relieve the SUPPLIER from responsibility for errors of any sort in the submittals and shop drawings.

When shop drawings and/or submittals are required to be revised or corrected and resubmitted, the SUPPLIER shall make such revisions and/or corrections and resubmit those items or other materials in the same manner as specified above.

Submitted data shall be sufficient in detail for determination of compliance with the Contract Documents. Color samples for all items for which colors are to be selected shall be submitted at the same time. No equipment or material for which listings, drawings, or descriptive material is required shall be installed until the SUPPLIER has received review from the ENGINEER.

Regardless of corrections made in or review given to the drawings by the ENGINEER, the SUPPLIER shall be responsible for the accuracy of such drawings and for their conformity to the drawings and specifications. The SUPPLIER shall check all submittals before submitting them to the ENGINEER and shall stamp its approval on all copies of the shop drawing documents. Any submittals received by the ENGINEER which do not bear the SUPPLIER's approval shall be returned without review. If more than two (2) submissions are required to meet the project specifications, the cost of reviewing these additional submissions may be charged directly against the SUPPLIER and the Owner may withhold the funds necessary to cover these costs.

Materials and equipment shall be ordered a sufficient time in advance to allow time for reviews, and shall be available on the manufacturing site when needed. Last minute review will not be given for inferior substitutes for material or equipment.

Required submittals include items listed below. This list is provided for SUPPLIER's convenience only and may not be complete in all respects. SUPPLIER shall provide all submittals required, whether or not specifically listed herein.

A. Schedules -- The SUPPLIER shall prepare and submit to the ENGINEER, within fifteen (15) days after notice to proceed, a practicable schedule showing the order in which the SUPPLIER proposes to carry out the work, the dates on which the important features of the work will start, and the contemplated dates for completing same. In addition to a time-scaled bar chart schedule depicting the project critical path, the SUPPLIER shall submit a detailed Critical Path Method (CPM) logic diagram. The CPM diagram and time-scaled bar chart shall include the following:

- Construction activities
- Submittal and approval of material samples and shop drawings
- Procurement of critical materials
- Fabrication, installation, and testing of special material and equipment
- Duration of work, including completion times of all stages and their sub-phases

The activities shall be separately identifiable by coding or use of sub-networks or both. The duration of each activity shall be verifiable by manpower and equipment allocation, in common units of measure, or by delivery dates and shall be justifiable by the SUPPLIER upon the request of the ENGINEER.

Detailed subnetworks will include all necessary activities and logic connectors to describe the work and all restrictions to it. In the restraints, include those activities from the project schedule which initiated the subnetwork as well as those restrained by it.

Include a tabulation of each activity in the computer mathematical analysis of the network diagram. Furnish the following information as a minimum for each activity:

- Event (node) number(s) for each activity
- Activity description
- Original duration of activities (in normal workdays)
- Estimated remaining duration of activities (in normal workdays)
- Earliest start date or actual start date (by calendar date)
- Earliest finish date or actual finish date (by calendar date)
- Latest start date (by calendar date)
- Latest finish date (by calendar date)
- Slack or float time (in workdays)

Computer printouts shall consist of at least a node sort and an “early start/total-float” sort.

SUPPLIER’s attention is drawn to typical local climatic weather patterns and the SUPPLIER shall coordinate work accordingly.

- B. Shop Drawings, Schedules and Drawings -- The SUPPLIER shall provide shop drawings, schedules and such other drawings and information as may be necessary for the prosecution of the work in the shop and in the field as required by the contract documents and/or ENGINEER's instruction.
- C. Design Submittals -- Design submittals as may be required for equipment and systems elsewhere in these Specifications.
- D. Materials Lists
- E. SUPPLIER Contact Persons
- F. Material Safety Data Sheets
- G. Miscellaneous Materials and Other Submittals As Required Elsewhere in the Specifications

H. Operation and Maintenance Instructions

Before acceptance of the installation, the SUPPLIER shall submit four (4) copies of complete operation and maintenance instructions for all equipment supplied. Submit items in 8-1/2 x 11-inch heavy-duty three-ring binders when appropriate, or in 8-1/2 x 11-inch file folders. All binders and folders shall have clear plastic pockets on the front of the cover and the spine to allow for insertion of identifying information. The equipment manufacturer may furnish instruction manuals prepared specifically for the equipment furnished or standard manuals may be used if statements like "if your equipment has this accessory..." or listings of equipment not furnished are eliminated. Poorly reproduced copies are not acceptable. Operation and maintenance instructions shall contain the following as a minimum:

1. Approved shop drawings and submittal data
2. Model, type, size and serial numbers of equipment furnished
3. Equipment and driver nameplate data
4. List of parts showing replacement numbers
5. Recommended list of spare parts
6. Complete operating instructions including start-up, shutdown, adjustments, cleaning, etc.
7. Maintenance and repair requirements including frequency and detailed instructions
8. Name, address and phone numbers of local representative and authorized repair service

END OF SECTION

SECTION 03400

PRECAST CONCRETE

PART 1 GENERAL

1.1 Description

- A. This section covers concrete work if performed in the manufacturing of the packaged pump station.

1.2 Codes and Standards

Comply with the provisions of the following codes, specifications, and standards except as otherwise shown or specified.

- A. General: The latest edition of all specifications, codes, and standards listed herein shall be used.
- B. Codes: All design and construction shall meet the requirements of the Uniform Building Code except where local codes or the Contract Documents are more restrictive.
- C. Commercial Standards

ACI 301	Specifications for Structural Concrete for Buildings
ACI 315	Details and Detailing of Concrete Reinforcement
ACI 318	Building Code Requirements for Reinforced Concrete
ASTM C150	Specification for Portland Cement
ASTM A 48	Specification for Gray Iron Castings
ASTM C 923	Resilient Connectors between Reinforced Concrete Manhole Structures and Pipes
CRD-C 621	Corps of Engineers - Specification for Non-Shrink Grout

1.3 Submittals

- A. The SUPPLIER shall submit design calculation and Shop Drawings for all precast concrete items. Submitted Shop Drawings shall show all dimensions,

locations, and types of lifting inserts, details of reinforcement, connection embeds, joints, and grating in accordance with the Contract requirements.

- B. For all precast items which are manufactured, the SUPPLIER shall also submit a list of the design criteria used by the manufacturer.

1.4 Quality Assurance

Quality assurance shall be in accordance with the standards identified in Section 1.2 C of this section.

PART 2 PRODUCTS

2.1 General

The design and construction of all precast items shall be in accordance with the recommendations and requirements of ACI 301, ACI 315 and ACI 318.

2.2 Concrete Work

Dimensions shall be as required by the Drawings.

- C. Material: Concrete used shall have a minimum 3,000 pounds per square inch (psi) compressive strength at 28 days. Cement used shall be ASTM C150, Type II. Concrete shall have a maximum water-cement ratio of 0.50 and an air content of 4 to 6 percent.
- D. Joints: Walls shall be cast so that all sides are continuous at corners and along their full length with no blockouts or knockouts. Horizontal joints may be provided so that walls can be placed in horizontal segments. All horizontal joints shall be keyed to prevent offsets and shall be provided with a watertight gasket.
- E. Finish: Formed surfaces shall be smooth and uniform with no fins, bulges, or other irregularities. Any void greater in width than $\frac{1}{2}$ inch or deeper than $\frac{3}{8}$ inch shall be repaired. Unformed interior slab surfaces shall have a smooth steel trowel finish. Unformed exterior slab surfaces shall have a light broom finish applied to a steel trowel finish.
- F. Loadings: Loadings must meet the applicable requirements of the listed commercial standards.

- H. Mechanical Details: Piping, electrical, and other details shall be as required by the Contract Documents. No knockouts shall be cast into walls. All pipe penetrations shall be preformed or core drilled at the required locations.
- I. Accessories: Accessories such as ladders, floor grates at sumps, and other features shall be provided as shown on the approved submittals.

PART 3 EXECUTION

3.1 General

- A. The SUPPLIER shall design the method of placement for all precast items and shall add all reinforcing steel, embedments, bracing, and other items necessary for such placement. All portions of embeds which remain embedded in the concrete shall be made of stainless steel.
- B. The SUPPLIER shall safely install all precast items with no damage to the precast item or any other structure, piece of equipment, or appurtenance.
- C. Precast structures shall be installed in accordance with the manufacturer's recommendations.
- D. Joints: All joints shall be sealed watertight by the use of rubber gaskets or pre-formed sealant. All joints shall then be filled with non-shrink grout inside and out to produce smooth interior and exterior surfaces.

END OF SECTION

SECTION 03600

GROUT

PART 1 GENERAL

1.1 Description

- A. The SUPPLIER shall furnish all materials for grout in accordance with the provisions of this section and shall form, mix, place, cure, repair, finish, and do all other work as required to produce finished grout in accordance with the requirements of the Contract Documents.
- B. Work covered in this section includes:
 - 1. Removal of loose and spalling grout and concrete.
 - 2. Anchoring, patching, grouting, and sealing.
- C. The following types of grout shall be covered in this section:

Non-shrink grout: This type of grout is to be used wherever grout is required in the Contract Documents, unless another type is specifically referenced.

1.2 Reference Specifications, Codes, and Standards

- A. Specifications, codes, and standards shall be as specified in Section 03100, Concrete Work, and as referred to herein.
- B. Commercial Standards

CRD-C 621 Corps of Engineers Specification for Non-Shrink Grout

ASTM C 109 Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-inch or 50-mm Cube Specimens)

ASTM C 531 Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical - Resistant Mortars, Grouts, and Monolithic Surfacing

ASTM C 579 Test Methods for Compressive Strength for Chemical - Resistant Mortars and Monolithic Surfacing

ASTM C 827 Test Method for Early Volume Change of Cementitious Mixtures

1.3 Submittals

The SUPPLIER shall submit certified test results verifying the compressive strength, shrinkage, and expansion requirements specified herein; and manufacturer's literature containing instructions and recommendations on the mixing, handling, placement, and appropriate uses for each type of non-shrink and epoxy grout used in the Work.

1.4 Quality Assurance

Field Tests

- A. All grout already placed that fails to meet the requirements of these Specifications is subject to removal and replacement at the cost of the Contractor.

PART 2 PRODUCTS

2.1 Prepackaged, Non-Shrink Grouts

- A. Non-shrink grout shall be a prepackaged, inorganic, non-gas- liberating, non-metallic, cement-based grout requiring only the addition of water. Manufacturer's instructions shall be printed on each bag or other container in which the materials are packaged. The specific formulation of each class of non-shrink grout specified herein shall be that recommended by the manufacturer for the particular application.
- B. Class A non-shrink grouts shall have a minimum 28-day compressive strength of 5,000 psi; shall have no shrinkage (0.0 percent) and a maximum of 4.0 percent expansion in the plastic state when tested in accordance with ASTM C-827; and shall have no shrinkage (0.0 percent) and a maximum of 0.2 percent expansion in the hardened state when tested in accordance with CRDC 621.
- C. Class B non-shrink grouts shall have minimum 28-day compressive strength of 5,000 psi and shall meet the requirements of CRD C621.
- D. Application
 - 1. Class A non-shrink grout shall be used for the repair of all holes and defects in concrete members which are water-bearing or in contact with soil or other fill material, grouting under all equipment base plates, and at all locations where grout is specified in the Contract Documents except for those applications for Class B non-shrink grout specified herein. Class A non-shrink grout may be used in place of Class B non-shrink grout for all applications at the Contractor's option.

2. Class B non-shrink grout shall be used for the repair of all holes and defects in concrete members which are not water-bearing and not in contact with soil or other fill material, grouting under all base plates for structural steel members, and grouting railing posts in place.

2.2 Consistency

- A. The consistency of grouts shall be that necessary to completely fill the space to be grouted for the particular application. Dry pack consistency is such that the grout is plastic and moldable but will not flow. Where “dry pack” is called for in the Contract Documents, it shall mean a grout of that consistency; the type of grout to be used shall be as specified herein for the particular application.
- B. The slump for topping grout and concrete fill shall be adjusted to match placement and finishing conditions but shall not exceed 4 inches.

2.3 Measurement of Ingredients

- A. Measurements for cement grout shall be made accurately by volume using containers approved by the ENGINEER. Shovel measurement shall not be allowed.
- B. Prepackaged grouts shall have ingredients measured by means recommended by the manufacturer.

PART 3 EXECUTION

3.1 General

- A. All surface preparation, curing, and protection of cement grout shall be as specified by the manufacturer. The finish of the grout surface shall match that of the adjacent concrete.
- B. Base concrete or masonry must have attained its design strength before grout is placed, unless authorized by the ENGINEER.

3.2 Grouting Procedures

Prepackaged Grouts: All mixing, surface preparation, handling, placing, consolidation, curing, and other means of execution of prepackaged grouts shall be done according to the instructions and recommendations of the manufacturer.

END OF SECTION

SECTION 05500

METAL FABRICATIONS

PART 1 GENERAL

1.1 Description

- A. The extent of metal fabrications work will be at the discretion of the SUPPLIER and includes items fabricated from iron, steel, and stainless steel, using plates, bars, sheets, strips, tubes, pipes, and castings which are not a part of structural steel or other metal systems in other sections of these Specifications.
- B. The types of miscellaneous metal items include, but are not limited to, the following:
 - 1. miscellaneous framing, fabrication, and supports; and
 - 2. rough hardware.
- C. This section is provided as a guide to the SUPPLIER for metal fabrication work performed at the factory. Where this section is applicable, the SUPPLIER is responsible for following these specifications unless otherwise noted on the plans.
- D. If it is in the best interest of the Owner, for the SUPPLIER to deviate from these specifications, the SUPPLIER must note the deviation in the package pump station proposal.
- E. Upon delivery, if applicable metal fabrications did not adhere to these specifications and were not noted in the proposal, the SUPPLIER will be responsible for remedying the fabrications to the Owner's approval at no cost to the Owner.

1.2 Reference Specifications, Codes, and Standards

- A. Codes and Standards: Comply with the provisions of the following codes, standards, and specifications, except as otherwise shown and specified:
 - 1. AISC: "Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings", including "Commentary of the AISC Specifications"
 - 2. AISC: "Specifications for the Design of Cold-Formed Steel Structural Members"

3. AWS: “Structural Welding Code”
 4. Standard Specifications for Metal Bar Grating in the “Metal Bar Grating Manual”, National Association of Architectural Metal Manufacturers (NAAMM), 1981
- B. Qualification for Welding Work: Qualify welding processes and welding operators in accordance with AWS 1.1 “Standard Qualification Procedure”
 - C. Field Measurements: MANUFACTURER shall take field measurements prior to preparation of Shop Drawings and fabrication. Do not delay job progress; allow for trimming and fitting where taking field measurements before fabrication.
 - D. Shop Assembly: Preassemble items in the shop to the greatest extent possible, so as to minimize field splicing and assembly of units at the project site. Disassemble units only to the extent necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

1.3 Proposal Elements

- A. MANUFACTURER’s Data – Miscellaneous Metal, General: For information only, submit copies of manufacturer’s specifications, load tables, dimension diagrams, anchor details, and installation instructions for products to be used in miscellaneous metal work, including paint products.
- B. Shop Drawings – Miscellaneous Metal, General: Submit copies of Shop Drawings for the fabrication and erection of all assemblies of miscellaneous metal work which are not completely shown by the manufacturer’s data sheets. Include plans, elevations, and details of sections and connections and fabricator’s proposed shop coat paint or galvanizing specifications. Show anchorage and accessory items. Furnish setting drawings, diagrams, templates, instructions, and directions for installation of anchorages, such as concrete inserts, anchor bolts, and miscellaneous items having integral anchors, which are to be embedded in concrete construction.
- C. Samples – Miscellaneous Metal, General: Submit two sets of representative samples of materials and finished products as may be requested by the ENGINEER. ENGINEER’s review will be for color, texture, style, and finish only.

1.4 Delivery, Handling, and Storage

Delivery, handling, and storage of metal fabrications shall be in accordance with manufacturer’s requirements.

PART 2 PRODUCTS

2.1 General

For the fabrication of miscellaneous metal work items which will be exposed to view, use only materials which are smooth and free of surface blemishes including pitting, seam marks, roller marks, rolled trade names, roughness, and defects which impair strength, durability, and appearance. Remove such blemishes by grinding or by welding and grinding prior to cleaning and application of surface finishes including zinc coatings.

2.2 Materials

- A. Steel Plates, Shapes, and Bars: ASTM A 36
- B. Steel Plates to be Bent or Cold Formed: ASTM A 283, Grade C
- C. Steel Tubing: Hot formed, welding or seamless, ASTM A 500, Grade B
- D. Steel Bars and Bar-Size Shapes: ASTM A 36
- E. Cold-Finished Steel Bars: ASTM A 108, grade as selected by fabricator
- F. Cold-Rolled Carbon Steel Sheets: ASTM A 366
- G. Galvanized Carbon Steel Sheets: ASTM A 526, with ASTM A 525, G 90 zinc coating
- H. Gray Iron Castings: ASTM A 48, Class 30
- I. Malleable Iron Castings: ASTM A 47, grade as selected
- J. Steel Pipe: ASTM A 53, Type E or S; Grade A; galvanized standard weight (Schedule 40), unless otherwise indicated
- K. Structural Aluminum Shapes and Plates: ASTM B 308, Alloy 6061-T6, Anodic Coating Class I, AA-C22-A41, anodized after fabrication
- L. Non-shrink Nonferrous Grout: CE CRD C588

2.3 Anchors

All concrete anchors shall be epoxy anchors. Where shown, the following anchors shall be provided:

- A. Threaded-type Concrete Inserts: Galvanized ferrous casting, internally threaded to receive machine bolts; either malleable iron complying with ASTM A 47, cast steel complying with ASTM A 27; hot dip galvanized or, Type 304 stainless steel complying with ASTM A 320.
- B. Wedge-type Concrete Inserts: Galvanized box-type ferrous castings, designed to accept bolts having special wedge-shaped heads; either malleable iron complying with ASTM A 47 or cast steel complying with ASTM A 27; hot-dip galvanized; provide carbon steel bolts having special wedge-shaped heads, nuts, washers and shims; all galvanized in compliance with ASTM A 153.
- C. Slotted-type Concrete Inserts: Galvanized $\frac{1}{8}$ -inch thick pressed steel plate complying with ASTM A 283; box-type welded construction with slot designed to receive square head bolt and with knockout cover; hot-dip galvanized, or stainless steel as noted.
- D. Epoxy Anchors: HVA adhesive anchor system by Hilti or approved equal.
- E. Proprietary products as named on the Drawings, or approved equal.

2.4 Fasteners

Provide zinc-coated fasteners with galvanizing complying with ASTM A 153 or stainless steel as noted on Drawings and elsewhere in the Specifications. Select fasteners for the type, grade and class required for the installation of miscellaneous metal items. Where stainless steel bolts are in contact with dissimilar metals, glass epoxy insulating sleeves and washers shall be used to electrically isolate the bolts. Fasteners to be as follows:

- A. Standard Bolts and Nuts: ASTM A 307, Grade A, regular hexagon head
- B. Stainless Steel Bolts, Nuts, and Washers: 316 SS
- C. High Strength Bolts: ASTM A 325, regular hexagon head
- D. Lag Bolts: FS FF-B-561, hex head type
- E. Machine Screws: FS FF-S-92
- F. Wood Screws: FS FF-S-111, flat head carbon steel
- G. Plain Washers: FS FF-W-92, round, general assembly grade carbon steel
- H. Lock Washers: FS FF-W-84, helical spring type carbon steel
- I. Toggle Bolts: Tumble-wing type: FS FF-B-588, type class and style as required

- J. Masonry Anchorage Devices: Expansion shields, FS FF-S-325

2.5 Paint (Where Applicable)

- A. Metal Primer Paint: Primer paint selected must be compatible with the required finish coats of paint. Coordinate selection of metal primer with finish paint requirements specified in Division 9 of these Specifications. At locations in contact with potable water, use only primer approved for potable water use.
- B. Galvanizing Repair: Comply with ASTM - A780, A1. Repair Using Zinc-Based Alloys (heat and stick method).
- C. Protection of Aluminum: Aluminum materials in contact with concrete, other metals or other masonry materials shall have surfaces coated with one coat of Koppers 654 Epoxy Primer 1 to 2 mils dry film (D.F.), followed by 2 coats of Koppers Bitumastic No. 300-M 6 to 8 mils D.F., or one coat of Porters 7650 Epoxy Primer 1 to 2 mils D.F., followed by 2 coats of Porters Tarsel C-200 6 to 8 mils D.F., or equal.

2.6 General Fabrication

- A. Workmanship: Use materials of the size and thicknesses shown or if not shown, of the required size and thickness to produce adequate strength and durability in the finished product for the intended use as approved by the ENGINEER. Work to the dimensions shown or accepted on Shop Drawings, using proven details of fabrication and support. Use the type of materials shown or specified for the various components of work.

Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges. Ease exposed edges to a radius of approximately $\frac{1}{32}$ inch unless otherwise shown. Form bent-metal corners to the smallest radius possible without causing grain separation or otherwise impairing the work.

- B. Weld corners and seams continuously and in accordance with the recommendations of AWS. At exposed connections, grind exposed welds smooth and flush to match and blend with adjoining surfaces.
- C. Form exposed connections with hairline joints, which are flush and smooth, using concealed fasteners wherever possible. Use exposed fasteners of the type shown or, if not shown, use Phillips flathead (countersunk) screws or bolts.
1. Provide the anchorage of the type shown, coordinated with the supporting structure and the progress schedule. Fabricate and space anchoring devices to provide adequate support for the intended use of the work.

2. Cut, reinforce, drill and tap miscellaneous metal work indicated to receive finish hardware and similar items of work.
- D. Galvanizing: Provide a zinc coating for galvanizing for all steel using the hot-dip process after fabrication, unless otherwise specified.
- ASTM A 153 for galvanizing of iron and steel hardware
- ASTM A 123 for galvanizing of rolled, pressed and forged steel shapes, plates, bars and strip 1/8-inch thick and heavier
- ASTM A 385 for providing high quality zinc coatings (Hotdip)
- ASTM A 386 for galvanizing of assembled steel products
- E. Shop Painting (when allowed)
1. Shop paint miscellaneous metal work in accordance with Section 09900 and these Specifications, except those members or portions of members to be embedded in concrete or masonry, surfaces and edges to be field welded and galvanized surfaces unless otherwise indicated.
 2. Remove scale, rust and other deleterious materials before the shop coat of paint is applied. Clean off heavy rust and loose mill scale in accordance with SSPC SP-7 "Brush-off Blast Cleaning". Remove oil, grease and similar contaminants in accordance with SSPC SP-1 "Solvent Cleaning".
 3. Apply one shop coat of metal primer paint to fabricated metal items, except apply two coats of paint to surfaces which are inaccessible after assembly or erection. Change color of second coat to distinguish it from the first.
 4. Immediately after surface preparation, brush or spray on metal primer paint, applied in accordance with the manufacturer's instructions.

2.7 Miscellaneous Framing and Supports

- A. Provide miscellaneous steel framing and supports required to complete the work.
- B. Fabricate miscellaneous units to the sizes, shapes and profiles shown or, if not shown, of the required dimensions to receive adjacent grating, plates doors, or other work to be retained by the framing. Except as otherwise shown, fabricate from structural steel shapes and plates and steel bars, of all welded construction using mitered corners, welded brackets and splice plates and a

minimum number of joints for field connection. Cut, drill, and tap units to receive hardware and similar items to be anchored to the work.

- C. Equip units with integrally welded anchors for casting into concrete, bolting to structural steel or building into masonry. Furnish inserts if units must be installed after concrete is placed unless indicated otherwise in plans.

2.8 Miscellaneous Fabrications

- A. Prepare miscellaneous fabrications of the sizes, shapes and profiles shown. Except as otherwise shown, fabricate from structural steel shapes, bars and plates of all welded construction using metered corners, welded brackets and splice plates and a minimum of joints for field connection.
- B. Galvanize all miscellaneous fabrications unless otherwise noted.

PART 3 EXECUTION

3.1 Preparation

Furnish setting drawings, diagrams, templates, and directions for the installation of anchorages, such as concrete inserts, anchor bolts, and miscellaneous items having integral anchors, which are to be embedded in concrete or masonry construction. Coordinate the delivery of such items to the project site.

3.2 Installation

- B. Field Welding: Comply with AWS code for the procedures of manual shielded metal-arc welding, the appearance and quality of welds made, and the methods used in correcting welding work.
- C. Touch-up Painting, Pre-Painted Items: Immediately after erection, clean field welds, bolted connections, and abraded areas of the shop paint, and paint all exposed areas with the same material as that used for shop painting. Apply by brush or spray to provide a minimum dry film thickness of the original coating thickness.
- E. Galvanizing Repair: Repair any damaged areas by heat and stick method as may be required.

END OF SECTION

SECTION 06050

FASTENERS AND ADHESIVES

PART 1 GENERAL

1.1 Description

This section specifies the requirements for fasteners and adhesives used in the construction of the package pump station building.

PART 2 PRODUCTS

- 2.1 Rough Carpentry Hardware: Rough carpentry hardware used in building construction shall conform to the latest provisions of the Washington State Building Code, the International Building Code (IBC), and to any local codes and ordinances.
- 2.2 Nails: Steel common nails for framing, appropriately sized for the materials being joined. Use hot dipped galvanized nails wherever exposed.
- 2.3 Bolts and Screws: Conforming to ASTM A307, appropriately sized for the materials being joined. Use galvanized bolts and screws where exposed.
- 2.4 Framing Anchors, Joist, Rafter, and Beam Hangers: Use galvanized minimum 18-gauge steel of the size and type required for the materials connected. Simpson "Strong-Tie," Teco "Lumber Lok," Silver Metal Products, or approved equal.
- 2.5 Adhesives: Use gun grade adhesive suitable for bonding various metals and non-metallic materials such as wood, plastic and glass without primer. Submit manufacturer's data for approval by Engineer.

PART 3 EXECUTION

3.1 General

Use only skilled workers and the highest standards of the craft. Lay out, cut, fit, and install all rough carpentry items. Anchor sufficiently to ensure rigidity and permanence as noted on the Drawings.

END OF SECTION

SECTION 06100

ROUGH CARPENTRY

PART 1 GENERAL

1.1 Scope

This section covers the work necessary to furnish materials, labor, equipment and services necessary to provide rough framing as shown on the Drawings and as specified herein.

1.2 Submittals

The SUPPLIER shall submit a complete list of products, product information, types, and grades for approval.

1.3 Quality Assurance

All work specified herein shall conform to the latest provisions of the International Building Code (IBC), the Plastic Lumber National Evaluation Service, NER-508, and the local Codes and Ordinances of the City of Shelton and the State of Washington.

1.4 Delivery, Handling and Storage

Immediately upon delivery to manufacturing site, place materials in an area protected from weather. Protect sheet materials from breaking corners and damaging surfaces while unloading.

PART 2 PRODUCTS

2.1 Materials

- A. Lumber grading rules and wood species shall be in conformance with U.S. Product Standard PS 20-70 and the National Forest Products Association. The wood members shall conform to the requirements above and provide design values equal to those published in the "Design Values for Wood Construction," a supplement to the 1991 edition of the National Design Specification for Wood Construction, published by the National Forests Products Association.
- B. Plywood grading rules shall be in conformance with latest edition of U.S. Product Standard PS 1, and the APA.

2.2 Grade Marks

Each piece of lumber shall be stamped or branded with the grade as determined by an approved grading association indicating conformance with U.S. Product Standard PS 20-70.

Each panel of plywood shall be identified with the appropriate grade trademark of the American Plywood Association.

Moisture content shall not exceed 19 percent unless otherwise specified.

2.3 Lumber

Dimensions given are nominal. Surface four sides (S4S) unless specified otherwise.

Unless otherwise noted, lumber shall be as follows:

<u>Use</u>	<u>Minimum Grade</u>
General framing, studs, plates, blocking, furring, braces and nailers	Standard & Better or Stud Grade Douglas Fir, Hemlock, or Larch
Structural light framing, 2 inches to 4 inches thick, 2 inches to 6 inches wide	Douglas Fir Larch No. 2
Structural joists, rafters and planks, 2 inches to 4 inches thick, 5 inches and wider and headers	Douglas Fir Larch No. 2
Beams, stringers, posts, timber	Douglas Fir Larch No. 1
Fascia Board	TREX wood polymer as manufactured by TREX LLC.
Sills and Plates	Standard Grade, Treated in accordance with UBC Standard 25-12

2.4 Plywood

- A. Roof sheathing shall conform to APA rated sheathing, exposure 1, ½ inch or greater, grade CCX. Span rated 32/16 per APA.
- B. MDO: APA rated Medium Density Overlay exterior glue.

2.5 Building Paper

Asphalt-saturated felt conforming to ASTM D 226 or D 250, Type I, plain, non-perforated.

2.6 Plastic Lumber

“TREX” wood polymer lumber as manufactured by TREX LLC. Plastic lumber shall conform to ASTM E84 (Flame Spread) and ASTM D1413 (Fungus Resistance).

PART 3 EXECUTION

3.1 General

Use only skilled workers and the highest standards of the craft. Plan work in advance and perform in proper sequence to facilitate prompt and continuous progress of the Work.

3.2 Conditions of Surfaces

Verify that surfaces to receive rough carpentry materials are prepared to exact grades and dimensions.

3.3 Installation

A. Plates

Set level and flush with outside face of concrete or masonry unit walls or as shown on the Drawings. Anchor into concrete or masonry unit walls with specified anchors. Location and spacing of plate anchorages shall be as shown or, if not shown, in conformance with current local building codes.

B. Stud Framing

1. Plates and Stud Members

Provide single pressure-treated bottom plates for the tops of all concrete or masonry unit walls, 1½ inches thick by 5½ inches wide (2×6). Provide double top plates for the tops of the wood framed interior partition wall, 1½ inches thick by 5½ inches wide (2×6). Splice top plates at corners and intersections with an appropriate framing anchor as specified in Section 06050, Fasteners and Adhesives.

Provide studs in continuous lengths without splice.

End nail studs to bottom plate and end nail to lower top plate where required.

Facenail upper top plate to lower top plate.

Anchor plates to concrete or CMU walls.

2. Blocking

Install continuous, staggered horizontal row where shown on Drawings or required by code.

Locate blocking to facilitate installation of finishing materials, fixtures, specialty items, hardware, and trim.

- C. Engineered Trusses: SUPPLIER shall provide stamped, engineered calculations and design for trusses for approval during submittal process. Furnish and install engineered trusses in accordance with approved submittals.

D. Roof Sheathing

Install plywood with face grain perpendicular to supports using panel with continuous end joints over two or more spans staggered between panels and located over supports.

Allow minimum space $\frac{1}{16}$ inch (1.6 mm) between end joints and $\frac{1}{8}$ inch (3.2 mm) at edge joints for expansion and contraction of panels.

Support edge joints by use of ply clips or lumber blocking, unless noted otherwise on Drawings.

- E. Ceiling Plywood: Install ceiling plywood where shown on Drawings with joints transverse to the members to which they attach. Attach plywood sheets to wood framing using finish nails. Countersink nails. Spackle and sand joints, knot holes, and nail holes as required to provide a smooth uniform surface prior to application of paint coating system as specified in Section 09800.

END OF SECTION

SECTION 07200
BUILDING INSULATION

PART 1 GENERAL

1.1 Description

- A. The extent of insulation work is shown on Drawings and indicated by the provisions of this section.
- B. Applications of insulation specified in this section includes blanket-type and rigid insulation board building insulation.

1.2 Submittals

The SUPPLIER shall submit a complete list of products, product information, types, and grades for approval.

1.3 Product Handling

General Protection: Protect insulations from physical damage and from becoming wet, soiled, or covered with ice or snow. Comply with manufacturer's recommendations for handling, storage, and protection during installation.

PART 2 PRODUCTS

2.1 Materials

- A. Blanket-Type Insulation
 - 1. Provide HH-1-521F, Type II, Class C vapor barrier faced units with nailing flanges
 - 2. "R" Values: Ceilings R-38
- B. Rigid Insulation Boards
 - 1. Provide HH-I-1972/1 Polyisocyanurate, faced with aluminum foil on both sides.
 - 2. "R" Values: Walls R-21 Minimum

PART 3 EXECUTION

3.1 Installation

- A. Insulation must be installed in a dry environment.
- B. Stuff loose mineral fiber insulation into miscellaneous voids and cavity spaces.
- C. Set vapor barrier faced units with vapor barrier to warm side (winter) of construction. Do not obstruct ventilation spaces, except for firestopping.
- D. Extend insulation to full thickness as shown over entire area to be insulated. Cut and fit tightly around obstructions, and fill voids with insulation.

END OF SECTION

SECTION 07400
METAL ROOFING

PART 1 GENERAL

1.1 Scope

Work includes furnishing and installing a standing seam interlocking panel metal roof system with concealed fasteners where shown on the Drawings and as specified herein.

1.2 Submittal

- A. Product data and materials list of items proposed to be provided under this section.
- B. Sufficient technical data to demonstrate compliance with the specified requirements.
- C. Samples to include preformed panel, seam, fastener, base sheet, finish sheet, ridge, and trims if requested by the Engineer.

1.3 Quality Assurance

- A. Use skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the Work of this section.
- B. In addition to complying with requirements of governmental agencies having jurisdiction, comply with:
 - 1. Underwriters' Laboratories, Inc., Class 90 wind uplift
 - 2. Underwriters' Laboratories, Inc., Class A fire rating
 - 3. SMACNA: Pertinent recommendations contained in the "Architectural Sheet Metal Manual"

1.4 Delivery, Handling, and Storage

Comply with manufacturer's requirements for product delivery, handling, and storage.

PART 2 PRODUCTS

2.1 Materials

- A. Panels: 13½ inch maximum width continuous length interlocking hot-dip zinc-coated steel sheets, minimum 26 GA thickness, ASTM A-446, Grade C ASTM A-792-83 zinc coating. The panels shall meet UL Standard 2218, Class 4 impact resistant and Class A fire resistant rating.
- B. Metal Finish: Polyvinylidene fluoride resin (min 70 percent resin) finish coat applied over baked-on compatible prime coat. 1 mil minimum total coating system thickness, in manufacturer's standard color as selected by Owner.
- C. Roofing Membrane: Comply with ASTM D2626, Type 1, 30 pound.
- D. Slip sheet: Rosin-surfaced building paper weighing not less than 3 pounds per 100 square feet, W.R. Meadows Red Rosin Paper or equal.
- E. Anchors: 1-inch long, large head galvanized wood screws.

2.2 Fabrication

Shop fabricate to the maximum extent practicable. Brake-form to the indicated profile, length, and width.

2.3 Acceptable Manufacturers

- A. American Building Components
- A. Metal Sales Manufacturing Corporation
- B. ASC Building Products
- C. Fabral
- D. Approved Equal

PART 3 EXECUTION

3.1 Installation

- A. General
 - 1. Do not permit unnecessary walking on the finished roof. Require all personnel to wear rubber-soled shoes when installing or walking on the finished surfaces.

- B. Apply the specified roofing membrane over the entire area to be covered by sheet metal roofing.
 - 1. Start at the low edge and place succeeding courses in a shingle fashion, lapping edges 2 inches minimum.
 - 2. Lap the membrane with flashings as necessary to provide a positive barrier against penetration of water.
- C. Apply the specified slip sheet over the entire assembly. Scatter nail to sheathing as required to hold in position prior to application of metal panels.
- D. Install concealed anchor cleats at minimum 18-inch centers into roof sheathing.
- E. Install preformed metal panels in strict accordance with manufacturer's approved written installation instructions.
 - 1. Do not drive fasteners through panels or seams.
 - 2. Do not use tools or methods that scratch or mar the finish on exposed surfaces.

3.2 Cleaning and Protection

- A. **Damaged Units:** Replace panels and other components of the Work which have been damaged or have deteriorated beyond successful repair by means of finish touch-up or similar minor repair procedures.
- B. **Cleaning:** Remove protective coverings and strippable films (if any) at time in project construction sequence which will afford greatest protection of Work. Clean finished surfaces upon completion of Work as recommended by panel manufacturer.
- C. **Protection:** SUPPLIER shall advise the Contractor of protection and surveillance procedures, as required to ensure that Work of this section will be without damage or deterioration at time of substantial completion.

END OF SECTION

SECTION 07610

FLASHING AND SHEET METAL

PART 1 GENERAL

1.1 Scope

- A. The Work includes furnishing and installing each type of flashing and sheet metal, including gutters and downspouts, as indicated on the Drawings and by provisions of this section.
- B. They types of work specified in this section include the following:
 - 1. Galvanized metal flashings
 - 2. Pre-finished galvanized downspout and gutter

PART 2 PRODUCTS

2.1 Materials

- A. Pre-finished Galvanized Steel Sheet: 24 gauge, commercial quality galvanized steel sheet complying with ASTM A 525, G90 for hot-dip galvanizing, pre-finished with baked-on polyester coating not less than 1.0 mil thick. Provide material in color selected by OWNER.
- B. Galvanized Steel Sheet: 24 gauge minimum, commercial quality, galvanized steel sheet with minimum of 0.20 percent copper content, complying with ASTM A 525, G90 for hot-dip galvanizing, mill phosphatized, unless otherwise indicated.
- C. Gutter and downspouts shall be 24 gauge galvanized sheet metal and shall be fabricated K-style.
- D. Miscellaneous Materials and Accessories
 - 1. Solder: Except as otherwise indicated or recommended by metal manufacturer, provide 100 percent lead free solder for tinning and soldering galvanized metal joints.
 - 2. Visually Exposed Fasteners: Stainless steel pop rivets with heads finished to match color of pre-finished metal material.
 - 3. Concealed Fasteners: Zinc coated, type as required and recommended by manufacturer for materials and substrates involved.

4. Mastic Sealant: Polyisobutylene, non-hardening, non-skinning, non-migrating sealant typical for flashing lap joint applications.

2.2 Fabricated Units

A. General

1. Shop fabricate metal counter flashings, cap and sill flashings, and similar items to comply with profiles and sizes shown, and to comply with standard industry details as shown by SMACNA in the “Architectural Sheet Metal Manual.”
2. Comply with metal producers’ recommendations for tinning, soldering, and cleaning flux from galvanized metal fabrications. Provide stainless steel rivets at exposed fastenings in pre-finished metal fabrications.
3. Form exposed sheet metal work without oil-canning, buckling, and tool marks, true to line and level with exposed edges folded back to form hems.
4. Where movable joints are required for proper installation of mastic sealant, they shall be in compliance with SMACNA standards.

B. Pipe Jack Sleeve Fastenings

1. Fabricate pipe roof penetration sleeves from galvanized material fully tinned and soldered at seams. Provide stack sleeve of diameter ½ inch greater than penetrating pipe and same height above with a 3-inch high conical base and embedment flange 12 inches greater than diameter of base. Furnish flanges at top of stack sleeve for attachment of counter flashing cap.
2. Fabricate counter flashing cap with interior pipe sleeve and conical cap to fit over pipe and stack sleeve. Size interior sleeve to tightly fit pipe diameter and to extend into pipe not less than 3 inches. Size conical cap to extend not less than 3 inches below top of stack sleeve with space above to permit not less than 1 inch of pipe movement. Rivet counter flashing cap to flanges of stack sleeve.

C. Counter Flashings

1. Fabricate counter flashings from galvanized material to size and profiles shown in 10-foot minimum lengths with continuous 20 gauge galvanized cleat at hemmed lower drip edge.
2. Where top leg of counter flashing is not covered by other applied materials or otherwise supported, provide with integral hemmed sealant

dam and anchor to wall substrates with $\frac{1}{8}$ inch by $1\frac{1}{2}$ inch galvanized float bar, prepared with fastener holes drilled or punched at 8 inches OC. Coordinate size of holes with anchors to be used. Form sealant dam with $\frac{3}{4}$ -inch minimum outward-turned hemmed leg.

3. At inside and outside corners, provide double lapped, tinned, and fully soldered assemblies, shop assembled prior to installation. Do not solder flashing corners after installation other than to render remedial surface repairs. If joint separation should occur, remove flashings and re-solder as required.

D. Cap Flashings

1. Fabricate lap seamed cap flashings from galvanized material with hemmed drips on both sides and a continuous 20 gauge galvanized cleat at front edge.
2. Shop assemble cap end-to-wall closure flashings with double lapped, riveted, mastic-sealed construction. Provide vertical legs with sealant dam as required for counter flashings.

E. Wall Flashings

1. Fabricate wall flashings from galvanized material with flat-locked, mastic-filled vertical seams spaced not greater than 4 feet OC.
2. Form as required to closely follow substrate profile and interlock with counter and cap flashing assemblies without exposed fasteners. Secure to walls with 20 gauge galvanized cleat concealed by edge hems.

PART 3 EXECUTION

3.1 General

- A. Comply with manufacturer's instructions and recommendations for handling and installation of flashing and sheet metal work.
- B. Coordinate the work with other work for the correct sequencing of items which make up the entire membrane or system of weatherproofing and rain drainage. It is required that the flashing and sheet metal work be permanently watertight and not deteriorate in excess of manufacturer's published limitations.
- C. Coordinate Work of this section with interfacing and adjoining work for proper sequence of each installation. Provide flashing and sheet metal work which is fully compatible with interfacing or adjoining work to ensure the best total assembly performance for weather resistance and durability.

3.2 Installation of Metal Work

- A. Comply with details and profiles as shown, and comply with SMACNA “Architectural Sheet Metal Manual” recommendations for installation of the Work.
- B. For non-moving seams, provide sealed, flat-lock seams except as otherwise indicated. Comply with metal producers’ recommendations for tinning, soldering and cleaning the joints of soldered work.
- C. Provide for thermal expansion of all exposed sheet metal work exceeding 20-foot running length, except as otherwise indicated.
- D. Conceal fasteners and expansion provisions wherever possible. Fold back edges on concealed side of exposed edges to form a hem and stiffen material.
- E. Provide flashing reglets as shown or as required to seal Work to existing substrates. Seal assembled joint with sealant as indicated.
- F. Do not proceed with the installation of flashing and sheet metal work until curb and substrate construction, blocking, and other construction to receive the work is completed.
- G. Examine the substrate and the conditions under which flashing and sheet metal work is to be performed. Do not proceed with the work until unsatisfactory conditions have been corrected.
- H. Install gutters continuously without joints.

3.3 Cleaning and Protection

- A. Clean visually exposed metal surfaces and other surfaces indicated to be painted. Remove corrosive substances, including soldering flux, which might cause deterioration of metal surfaces or final finish.
- B. Provide surveillance and protection of flashings and sheet metal work during construction to ensure that work will be without damage or deterioration at time of acceptance by OWNER.

END OF SECTION

SECTION 07920

SEALANTS AND CAULKING

PART 1 GENERAL

1.1 Description

The Work includes sealing or caulking joints between dissimilar materials for watertight seal. Provide watertight caulked joints at all building exterior locations where water penetration through joint could occur. If caulking systems for such joints are not shown, provide as specifically approved.

Terminology: Where the words “sealants” or “caulking” are used in this text, they shall be considered to be synonymous and shall mean sealant or caulking compounds as specified under Part 2 of this specification.

PART 2 PRODUCTS

2.1 Materials

A. Type A Sealant

1. Application: General building sealant
2. Material: One component polyurethane sealant
 - a. Vulkem as manufactured by Tremco Construction Division
 - b. Sonolastic NP1 as manufactured by Sonneborn

B. Type B Sealant

1. Application: General building sealant for wide joints
2. Materials: Self leveling one component polyurethane
 - a. Dymeric as manufactured by Tremco Construction Division

C. Filler Gasket (Backer Rod) Cord Strip

1. Dow Chemical Ethafoam
2. Approved substitution

PART 3 EXECUTION

3.1 Preparation

Surfaces to receive caulking materials shall be thoroughly clean and free of any non-compatible primers or protective coatings including lacquers, form coatings, clear sealers, etc. Brush out all foreign matter and loose particles. Clean metal surfaces with solvents and wipe dry while the surface is still wet with solvent.

3.2 Primers and Bond Breakers

Apply to surfaces as required; verify with manufacturer. In general, prime all concrete and Portland-cement-based plaster or grout surfaces. Prime wood surfaces where specifically required. Use proper primers and bond breakers applied per sealant manufacturer's printed instructions.

3.3 Gaskets or Fillers

Compress all gaskets to a tight fit. Where required as backing for caulking system, roll or stretch in gasket sections to depth from sealant face or as shown (in general, to $\frac{3}{8}$ inch).

Install gun grade material with gun nozzle of similar size as joint width shown. Tool all beads after application to ensure full, firm contact. Strike off excess material.

Maintain edge surfaces adjacent to joints clean and free of caulking stain and excess material. Trim joints as required per manufacturer's printed instructions.

Do not apply caulking materials to a "bleeding" type of surface, such as asphaltic or other oil-emitting types. Where such material occurs at caulking joint (roofing, etc.), isolate it from caulking with gasket filler.

Avoid mixing any water in caulking mixture before and during application. Do not thin material.

3.4 Corrections and Cleanup

Remove all damaged, defective, or improperly installed sealant and/or caulking and replace. Clean and remove all sealant and caulking from adjacent surfaces.

Upon completion of the work, remove all disused implements, rubbish, and debris, and leave premises neat and clean.

END OF SECTION

SECTION 08100

METAL DOORS AND FRAMES

PART 1 GENERAL

1.1 Description

Work includes providing metal doors and door frames for the pump station of the described size, type and thickness specified herein and shown on plans.

1.2 Submittals

Submittals shall include manufacturer's information, shop drawings, and all product information necessary to ensure that the requirements of this section are met.

1.3 Quality Assurance

A. Materials

1. All material used in the fabricating of steel doors and frames shall be free from defects impairing strength, durability, and appearance. Doors shall conform to Commercial Standard CS 242-62 and PS4-66.
2. Doors and frames in accordance with Standard Steel Door Institute (SDI) recommendations -- SDI 100-78, extra heavy duty, Type III, 16 gauge, galvanized steel.
3. Doors and frames to be of a single manufacturer.

B. Hardware

1. Reinforce, drill and tap doors and frames to receive mortised hinges, locks, latches, flush bolts and concealed closer as required.
2. Hardware preparation in accordance with SDI 107. Manufacturer to drill and tap for surface applied hardware in accordance with SDI 107.

PART 2 PRODUCTS

2.1 Materials

A. Vertically Hung Doors

1. Doors shall be 1-3/4 inch full flush, fabricated from two sheets 16 gauge galvanized steel with no visible seams on either face. Doors shall be reinforced, stiffened, insulated with urethane core, and sound deadened. Doors shall be bonderized and finished with standard one-coat baked-on prime coat. Doors to be thoroughly degreased and cleaned of all imperfections before finish painting. Provide top caps on

exterior doors and 15 inches high by 12 inches wide stamped louver on interior doors where indicated.

Door shall be provided with 3/16-inch steel hinge reinforcements, 1/8-inch steel lock reinforcements all securely welded into place and each drilled and tapped to receive field installed finish hardware and shall open outward.

2. Manufacturer's standard, rigid, fully welded door frame provided in size as detailed, 16 gauge galvanized steel, double rabbet. Frames shall be furnished with standard one-coat baked-on prime coat ready to receive specified finish paint systems. Anchor doors to opening in accordance with manufacturers recommendations. All hardware shall be of manufacturer's standard design except as described in Section 08715 of these specifications.
3. Accepted Manufacturers – Republic Doors and Frames, Door Components, Inc, Ceco Door or Approved Equal.

PART 3 EXECUTION

3.1 Product Handling

- A. Delivery and Storage -- Store doors and frames at the manufacture site in dry area, complete protection between doors to insure against surface damage. Take special care at all times to prevent staining of door surface. Carry doors and frames when moving them; do not drag; do not slide one door across another.
- B. Replacements -- In the event of damage, immediately make all repairs and replacements necessary to the approval of the ENGINEER and at no additional cost to OWNER.

3.2 Installation

- A. Install plumb, straight, true, rigidly secured in place and properly braced all in accordance with manufacturer's recommendations.
- B. Fit and install specified hardware to operate freely and adjust doors before final acceptance.

3.3 Corrections and Cleanup

- A. Immediately after erection, sand smooth all rusted, or damaged areas of prime coat and apply touch up compatible primer.
- B. Finish Coatings - Provide finish coatings per Section 09800.

END OF SECTION

SECTION 08710

FINISH HARDWARE

PART 1 GENERAL

1.1 Description

Work includes furnishing and installing finish hardware on doors throughout manufacturing process of the package pump station.

1.2 Submittals

Submit copies of a complete vertical schedule of hardware, listing each opening, door size, hand, frame material, and door label. State keying, material finish, and manufacturer's number for each item.

Obtain ENGINEER's review before proceeding. Review does not relieve SUPPLIER of responsibility for items that may not be included on the schedule.

Schematic Keying Diagram.

One copy of transmittal notice sent to door and frame fabricator by hardware SUPPLIER.

PART 2 PRODUCTS

2.1 General

Exterior hollow steel doors shall be provided with a panic bar device on the interior, thumb latch opening device on the exterior, butts, locksets, cylinders, door stops and holders, closers, weatherstripping, silencers, threshold, drip cap, flush bolts and astragal as specified herein. All door accessory manufacturers shall be as specified.

2.2 Materials

A. Fasteners

1. Furnish necessary screws, bolts, and other fasteners of suitable size and type to anchor the hardware in position for long life under hard use.
2. Where necessary, furnish fasteners with expansion shields, toggle bolts, hex bolts, and other anchors approved by the ENGINEER, according to the material to which hardware is to be applied and according to the recommendations of the hardware manufacturer.

- B. At double exterior doors provide hot-dipped galvanized 1/4" x 2" metal flat bar astragal on exterior face of active door.

- C. Furnish complete Zero, #475A weatherstripping packages for all exterior door frames, covering complete length of stop face of jambs and heads.
- D. Furnish Glynn Johnson, W27 door stops and holders at all doors without automatic closers.
- E. Finish -- Satin
- F. Butts -- Provide 1½ pair, 4½-inch by 4½-inch standard weight concealed ball bearing hinges at each door. Provide non-rising pins at all exterior doors.
- G. Closer -- Provide LCN Smoothie Series. Meet ADA requirements.
- H. Threshold -- Pemco 2005 DS at each exterior door. Meet ADA standards.
- I. Drip Cap -- Reese, R201D at door head and at door sill.
- J. Silencers -- Glynn Johnson GJ 64 or 65; furnish three for each single door.
- K. Flush Bolts -- Glynn Johnson.
- L. Lockset -- Russwin, Sargent, or Schlage, "D" Series with cast lever-type handles. Meet ADA requirements.

2.3 Keying

- A. Keying to match OWNER's existing system. Coordinate with OWNER.
- B. Thumb Latch -- Von Duprin 99 TP for a 3ft wide door.
- C. Cylinders -- Best 1E72-626, removable cores.
- D. Furnish 4 keys per lock

2.4 Acceptable Products and Manufacturers

- A. Single source for items
 - 1. Except as specifically otherwise approved by the ENGINEER, furnish for each item (such as "door butt type 1") only the product of a single manufacturer (such as "Hager BB-800").
 - 2. To the maximum extent practicable, furnish similar items (such as "door butts") only as the product of a single manufacturer (such as "Hager").

2.5 Other Materials

Provide other materials, not specifically described but required for a complete and proper installation, as selected by the MANUFACTURER subject the approval of the ENGINEER.

PART 3 EXECUTION

3.1 Preparation

- A. Deliver products complete with necessary parts for fitting and installing. Wrap each in a separate package, distinctly labeled and numbered for each opening for which it intended. Check merchandise ordered from the factory before sending to the job site.
- B. Have an experienced person to receive, take charge of, and distribute hardware at the job site.

3.2 Installation

- A. Install mortised items, then remove and place in their original package until painters have completed their work, then fit permanently in place.
- B. Wrap hardware subject to hand usage during construction for protection. Keep finish free from blemishes or defects.
- C. Mount hardware in location and height as recommended by SDI.
- D. Adjust door closers for moderate swing in the sweep position and unless automatic flush bolts or panic hardware is used, adjust latch position for as slow a closing as practical.
- E. Place door stops at point of contact. In certain locations, it may be advantageous to place stop on the door.
- F. Ensure watertight joints at exterior doors.

3.3 Corrections and Cleanup

- A. Replace scratched or damaged hardware with new hardware.
- B. Remove protective maskings, clean surfaces.
- C. Upon completion of this work, remove all disused implements, rubbish, and debris, and leave premises neat and clean.

END OF SECTION

SECTION 08715

LOCKING HARDWARE

PART 1 GENERAL

1.1 Description

The SUPPLIER shall coordinate locking hardware to match master keying scheme encompassing all OWNER facilities. If the OWNER does not have a preferred locking hardware, all locking hardware shall be manufactured by, or be specifically designed for modification by installation of locking cores manufactured by Best, Schlage, or approved equal.

1.2 Packing, Marking and Delivery

Package each item of locking hardware separately in individual containers, complete with necessary screws, instructions, and installation templates. Mark each container with the item number corresponding to the number shown on the SUPPLIER's hardware schedule.

1.3 Submittals

Include a list of proposed locking hardware, provide sufficient data showing the requirements of this section are met.

PART 2 PRODUCTS

2.1 General

Provide locking hardware constructed to accept a figure-eight shaped, interchangeable core. This core must be completely detachable from the lock and usable in other locks (padlocks, deadbolts, cylindrical locksets, etc.) without alteration. The core shall be constructed with the segment barrels drilled from the top so that the segments can be loaded into the core without the necessity of disassembling the core plug from the core body. Proper location of the key bits under the core barrels shall be accomplished by having the nose of the key striking against the key stop.

All permanent cores shall have a minimum of seven active pin tumblers.

All keyways shall match those being used on the Owner's existing buildings.

Provide locking hardware with 7-pin cores, and TB keyway, all as manufactured by Best, Schlage, or approved equal.

2.2 Finish

Provide latching and locking hardware with BHMA 626 finish (satin chromium plated or brushed stainless) unless a different finish is specifically required by these Specifications.

2.3 Permanent Keys and Keying

Permanent keys shall be cut by Best Lock Corporation, Schlage, or a representative to combinations as directed by the Engineer. Permanent keys are to be shipped directly to the Owner.

2.4 Locksets

Provide heavy-duty cylindrical locksets with 2-3/4-inch backset as called for in the Plans. Locksets shall include cylindrical chassis, latch unit with deadlocking device, knob and rose.

Provide 83K heavy duty locksets as manufactured by Best Lock Corporation, Indianapolis, IN, Schlage equal, or approved equal. Provide locksets with Best "4" style knobs and "A" style roses, or equivalent.

Locksets on exterior doors shall be Best #83K-7-D-4A heavy duty cylindrical locks with deadlocking latch bolts (storeroom function), Schlage equal, or approved equal.

2.5 Exit Devices and Panic Bars

All exit devices, panic bars and other locking hardware not directly specified herein shall be capable of being fitted with locking cylinders manufactured by Best, Schlage, or approved equal. Locking cylinders shall conform to all applicable locking hardware requirements as specified herein.

PART 3 EXECUTION

3.1 General

Install all hardware in accordance with the manufacturer's instructions. All items of locking hardware shall be fitted, adjusted, and secured neatly and firmly in place. All hardware shall be in perfect working order when installation is complete.

END OF SECTION

SECTION 09800

PROTECTIVE COATINGS

PART 1 GENERAL

1.1 Description

- A. Work under this section shall include the protective coating of all specified surfaces including all surface preparation, pretreatment, coating application, touch-up of factory coated surfaces, protection of surfaces not to be coated, cleanup, and appurtenant work, all in accordance with the requirements of the Contract Documents.
- B. This specification is applicable to coated pipe, steel, concrete, and other surfaces listed in the coating schedule at the end of this section. Reservoir painting, pipe corrosion protection systems, galvanizing, and anodizing are specified elsewhere within the Contract Documents.
- D. Related Work Specified in Other Sections: Shop coatings and/or factory finishes on fabricated or manufactured equipment may be specified in other divisions. Some items with factory finishes or corrosion-resistant finishes may be scheduled or directed to be painted by the ENGINEER to unify a wall finish or color scheme at the ENGINEER's discretion.
- E. Exclusions: Do not coat the following surfaces unless specified or directed elsewhere: Stainless steel, aluminum, copper, brass, bronze and other corrosion-resistant material (except for valve bodies and piping); Electrical switch-gear and motor control centers having factory finish; fencing; multiple-coated factory-finished baked enamel, or porcelain products; concealed areas such as ducts, piping, conduits, and items specified elsewhere for special linings and coatings.
- F. Damaged Factory Finish: If directed by the ENGINEER, refinish the entire exposed surface of equipment that is chipped, scratched, or otherwise damaged in shipment or installation.
- G. All coating coming in to contact with potable water shall be NSF approved.

1.2 Reference Specifications, Codes, and Standards

- A. Comply with the provisions of the following codes, specifications, and standards, except as otherwise shown or specified.

1. "Architectural Specification Manual" by the Painting and Decorating Suppliers of America (PDCA), 333 Taylor Avenue North, Seattle, Washington 98109.
 2. "Systems and Specifications" - Volume 2 of Steel Structures Painting Council (SSPC).
 3. National Sanitation Foundation (NSF) Standard No. 61.
- B. References herein to "NACE" shall mean the published standards of the National Association of Corrosion Engineers, P.O. Box 986, Katy, TX 77450.
- C. Pipe Coating Commercial Standards
- | | |
|----------------|---|
| ANSI/AWWA C205 | Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4-inch and Larger - Shop Applied |
| ANSI/AWWA C210 | Liquid Epoxy Coating for Exterior and Interior of Steel Pipe. |
| ANSI/AWWA C213 | Fusion Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines. |
- D. Federal Specifications
- | | |
|------------------|--|
| DOD-P-23236A(SH) | Military Specification, Paint Coating Systems, Steel Ship Tank, Fuel and Salt Water Ballast. |
|------------------|--|

1.3 Submittals

- A. Coating Materials List: The SUPPLIER shall provide a coating materials list which indicates the coating manufacturer and the coating number keyed to the coating systems herein.
- B. Coating Manufacturer's and Applicator Information: For each coating system to be used, the SUPPLIER shall submit the following listed data.
1. Coating manufacturer's data sheet for each product used, including statements on the suitability of the material for the intended use.
 2. Coating manufacturer's instructions and recommendations on surface preparation and application.

3. Colors available for each product and each coat.
4. Compatibility of shop and field applied coatings (where applicable).
5. Material safety data sheet (MSDS) for each product used.
6. The coating manufacturer's recommended products and procedures for field coating repairs and field preparation of field cut pipe ends.
7. The name of the proposed coating applicator shop along with certification that the applicator shop is qualified and equipped to apply the coatings systems as specified.
8. Certificate: Submit coating manufacturer's certificate of compliance with the specifications and standards signed by a representative in the coating manufacturer's employ.
9. Samples: Provide painted surface areas at the job for approval of main color selections, or submit sample on 12-inch square sample of substrate using required finish system at ENGINEER's discretion.

1.4 Quality Assurance

- A. Painter Qualifications: The package pump station MANUFACTURER or Painting Contractor must be capable of performing the various items of work as specified. The MANUFACTURER shall furnish a statement covering experience on similar work, a list of machinery, plan and other equipment available for the proposed work, and a financial statement, including a complete statement of the MANUFACTURER's financial ability and experience in performing similar painting and coating work. The Painting/Coating Personnel shall have a minimum of 5 years of practical experience and a successful history in the application of the specified products to concrete/steel surfaces. Upon request, the MANUFACTURER shall substantiate this requirement by furnishing a list of references which shall include jobs of similar nature.
- B. Inspection by the ENGINEER, or the waiver of inspection of any particular portion of the work, shall not relieve the MANUFACTURER of its responsibility to perform the work in accordance with these Specifications.
- C. Surface Preparation: Evaluation of blast-cleaned surface preparation work will be based upon comparison of the blasted surfaces with the standard samples available from the NACE, using NACE standard TM-01-70.

- D. Paint Products: No request for substitution shall be approved which decreases the film thickness designated or the number of coats to be applied, or which offers a change from the generic type of coating specified. Painting shall be done at such times as the MANUFACTURER and ENGINEER may agree upon in order that dust-free and neat work is obtained. All painting shall be in strict accordance with the coating manufacturer's instructions and shall be performed in a manner satisfactory to the ENGINEER.
- E. Colors: Colors will be selected from coating manufacturer's standard colors as reviewed by the ENGINEER and approved by the OWNER. Colors for special coatings that are limited in their availability and color selection will be chosen on the basis of coating manufacturer's standard colors, provided that the coating manufacturer's product line represents a color range comparable to similar products of other coating manufacturers.
- F. Film Thickness Testing: On ferrous metals, the dry film coating thickness shall be measured in accordance with the SSPC "Paint Application Specification No. 2" using a magnetic-type dry film thickness gauge such as Mikrotest model FM, Elcometer model 111/1EZ, or approved equal. Each coat shall be tested for the correct thickness. No measurements shall be made until at least 8 hours after application of the coating. On non-ferrous metals and other substrates, the coating thicknesses shall be measured at the time of application using wet film gauge readings and destructive film thickness tests.
- G. Holiday Testing: The MANUFACTURER or Painting Contractor shall holiday test all coated ferrous surfaces. Areas which contain holidays shall be marked and repaired or recoated in accordance with the coating manufacturer's printed instructions and then retested.
1. Coatings with Thickness Exceeding 20 Mils: For surfaces having a total dry film coating thickness exceeding 20 mils: pulse-type holiday detector such as Tinker & Rasor Model AP-W, D.E. Stearns Co. Model 14/20, or approved equal shall be used. The unit shall be adjusted to operate at the voltage required to cause a spark jump across an air gap equal to twice the specified coating thickness.
 2. Coatings with Thickness of 20 Mils or Less: For surfaces having a total dry film coating thickness of 20 mils or less: Tinker & Rasor Model M1 nondestructive type holiday detector, K-D Bird Dog, or approved equal shall be used. The unit shall operate at less than 75 Volts. For thicknesses between 10 and 20 mils, a non-sudsing type wetting agent, such as Kodak Photo-Flo, or equal, shall be added to the water prior to wetting the detector sponge.

1.6 Protection

- A. Follow all safety recommendations of coating manufacturer regarding ventilation and danger from explosion or breathing paint fumes or skin exposure, and all applicable OSHA and other regulations.

PART 2 PRODUCTS

2.1 General

- A. Definitions: The terms "paint," "coatings," or "finishes" as used herein, shall include surface treatments, emulsions, enamels, paints, epoxy resins, tape, and all other protective coatings, excepting galvanizing or anodizing, whether used as a pretreatment, primer, intermediate coat, or finish coat. The term "DFT" means minimum dry film thickness.
- B. General: Coating materials shall be sealed in containers that plainly show the designated name, formula or specification number, batch number, color, date of manufacture, manufacturer's directions, and name of manufacturer, all of which shall be plainly legible at the time of use.
- C. The MANUFACTURER shall use coating materials suitable for the intended use and recommended by their manufacturer for the intended service.
- D. Compatibility: In any coating system, only compatible materials from a single manufacturer shall be used in the work. Particular attention shall be directed to compatibility of primers and finish coats. If necessary, subject to the approval of the ENGINEER, a barrier coat shall be applied between existing prime coat and subsequent field coats to ensure compatibility.
- E. Colors: All colors and shades of colors of all coatings shall be as selected or specified by the ENGINEER. Each coat shall be of a slightly different shade, to facilitate inspection of surface coverage of each coat. Finish colors shall be as selected from the manufacturer's standard color samples by the ENGINEER. Color pigments shall be lead free.
- F. Protective Coating Materials: Products shall be standard products produced by recognized manufacturers who are regularly engaged in production of such materials for essentially identical service conditions. Where requested, the SUPPLIER shall provide the ENGINEER with the names of not less than 10 successful applications of the proposed manufacturer's products demonstrating compliance with this specification requirement.

- G. Substitute or "Or-Equal" Submittals: Unless otherwise specified, materials are from the catalogs of the companies listed herein. Materials by other manufacturers are acceptable provided that they are established as being compatible with and of equal quality to the coatings of the companies listed. The SUPPLIER shall provide satisfactory documentation from the firm manufacturing the proposed substitute or "or equal" material that said material meets the specified requirements and is equivalent or better than the listed materials.
- H. The cost of all testing and analyzing of the proposed substitute materials that may be required by the ENGINEER shall be paid by the SUPPLIER. If the proposed substitution requires changes in the Contract, the SUPPLIER shall bear all such costs involved and the costs of allied trades affected by the substitution.

2.2 Industrial Coating Systems

A. General

Provide and apply the industrial coatings systems which follow as listed in the coating schedule, as required by these Specifications and as directed by the ENGINEER. Coat all existing and new exposed interior or exterior surfaces and submerged and intermittently submerged surfaces as indicated, except as specifically excluded in Part 1 of this section or on the Drawings or finish schedules. Coating System Numbers listed below shall be used as the Coating System code letter, and shall be used on any coating submittals or correspondence.

B. Industrial coating systems shall be as follows:

1. Coating System 100

- a. Location: Exposed, unprimed, non-galvanized, non-submerged metal surfaces, both interior and exterior including piping and structural steel.
- b. Surface Preparation: As specified herein.
- c. Coating System: Apply prime coat and topcoat, 4.0-6.0 mils each coat of Tnemec Series 66-2 Hi-Build Epoxoline, or approved equal. Color as selected by the OWNER.

2. Coating System 101

- a. Location: Exposed metal surfaces, shop primed, both interior and exterior including piping, railings, ladders, steel doors, and any other metal items not otherwise specified.
- b. Surface Preparation: As specified herein.
- c. Coating System: Apply shop prime coat 3.0 mils DFT Tnemec Series 90-97 Tneme-Zinc, one coat 4.0 - 6.0 mils DFT Tnemec Series 66 Hi-Build Epoxoline, and 3.0 - 4.0 mils DFT of Tnemec Series 175 Endura Shield, or approved equal. Color as selected by the OWNER.

3. Coating System 102

- a. Location: Unprimed or non-galvanized, continuously or intermittently submerged metal items, both interior and exterior including piping, structural steel, and all other metal items not otherwise specified.
- b. Surface Preparation: As specified herein.
- c. Coating System: Prime, intermediate and topcoat, 4.0-6.0 mils each coat of Tnemec Series 20 Pota-Pox, or approved equal. Color as selected by the OWNER.

2.3 Special Pipe and Severe Service Coating Systems

A. General

The following coatings are for buried pipe and surfaces used in severe service conditions. The manufacturers' products listed in this paragraph are materials which satisfy the material descriptions of this paragraph and have a documented successful record for long-term submerged or severe service conditions. Proposed substitute products may be considered. If the SUPPLIER desires to furnish items of equipment by manufacturers other than those specified, they shall secure the approval of the ENGINEER prior to placing a purchase order. No extras will be allowed the SUPPLIER for any changes required to adopt the substitute equipment.

B. Special pipe and severe service coating systems shall be as follows

1. Coating System 203: Fusion Bonded Epoxy

- a. Location: Ferrous surfaces of sleeve couplings, steel pipe, and fittings.
- b. Surface Preparation: As specified herein.
- c. Coating System: The coating material shall be a 100 percent powder epoxy applied in accordance with the ANSI/AWWA C213 "AWWA Standard for Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines". The coating shall be applied using the fluidized bed process.
 - i. Liquid Epoxy: For field repairs, the use of a liquid epoxy will be permitted, applied in not less than 3 coats to provide a DFT 16 mils. The liquid epoxy shall be a 100 percent solids epoxy recommended by the powder epoxy manufacturer.
 - ii. Coating (DFT = 16 mils), Scotchkote 203, or equal.
 - iii. Total system DFT = 16 mils.

2.4 Architectural Coating Systems

A. General

"Paint" as used herein means all coating systems materials, including primers, emulsions, enamels, stains, sealers and fillers, and other applied materials whether used as prime, intermediate, or top coat.

Fungus Control: Submit evidence for all paints attesting the passing of Federal Test Method Standard No. 141, Method 6271.1 showing no fungus growth or other approved test results.

Apply to surfaces under recommended environmental conditions and within the limitations established by the material manufacturer. Acrylics require 60 °F and above temperature and below 50 percent relative humidity. Apply water-based paints only when the temperature of surfaces to be painted and the surrounding air temperatures are between 50 °F and 90 °F unless otherwise permitted by the paint manufacturer's printed instructions.

B. Architectural coating systems shall be as follows

1. Coating System 300

- a. Location: Vertical, exterior concrete masonry unit walls exposed to view.
- b. Surface Preparation: As specified herein.
- c. Coating System: Apply prime, intermediate and top coat, 75 ft²/gal, 100 ft²/gal and 100 ft²/gal respectively for each coat of Tnemec Series 156 Envirocrete or approved equal. Color as selected by the OWNER.

2. Paint System 302

- a. Location: Interior concrete masonry unit walls and interior and exterior wood walls, ceilings and other wood surfaces not otherwise specified, exposed to view.
- b. Surface Preparation: As specified herein.
- c. Coating System: Prime as specified by coating manufacturer. Apply two coats 6.0 - 9.0 mils (100 ft²/gal) each coat, Tnemec Series 156 Envirocrete, or approved equal. Color as selected by the OWNER.

3. Paint System 303

- a. Location: Wood surfaces not otherwise specified, exposed to view.
- b. Surface Preparation: As specified herein.
- c. Coating System: Apply an alkyd primer as recommended by the manufacturer, 2 mils. Apply finish coats (two or more coats 6 mils total) of single component, water based acrylic latex coating, Tnemec Series 6, Carbolite 3350 or equal. Total DFT = 8 mils. Color as selected by the OWNER.

4. Paint System 305

- a. Location: Exterior brick surfaces not otherwise specified, exposed to view.
- b. Surface Preparation: Surfaces shall be cleaned with a manufacturers approved chemical cleaner and power washed. Surfaces shall be completely dry, free from efflorescence, oils,

paint and other contaminants before the coating system is applied. Coating system shall be applied according to the manufacturers published recommendations. A manufacturer's representative shall be present during application of the coating system, if required by the manufacturer's warranty.

- c. Coating System: Apply two coats of masonry water retardant material. The system shall be clear, non-staining, silane-modified-siloxane, Fabrishield 161, Rainstopper 1500, or equal. The selected coating system shall provide a minimum of a five-year manufacturer's warranty.

PART 3 EXECUTION

3.1 Storage, Mixing, and Thinning of Materials

- A. Manufacturer's Recommendations: Unless otherwise specified herein, the coating manufacturer's printed recommendations and instructions for thinning, mixing, handling, applying, and protecting its coating materials, for preparation of surfaces for coating, and for all other procedures relative to coating shall be strictly observed.
- B. All protective coating materials shall be used within the manufacturer's recommended shelf life.
- C. Storage and Mixing: Coating materials shall be protected from exposure to cold weather and shall be thoroughly stirred, strained, and kept at a uniform consistency during application. Coatings of different manufacturers shall not be mixed together.

3.2 Surface Preparation Standards

- A. The following referenced surface preparation specifications of the Steel Structures Painting Council shall form a part of this specification.
 - 1. Solvent Cleaning (SSPC-SP1): Removal of oil, grease, soil, salts and other soluble contaminants by cleaning with solvent, vapor, alkali, emulsion or steam.
 - 2. Hand Tool Cleaning (SSPC-SP2): Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, by hand chipping, scraping, sanding, and wire brushing.

3. Power Tool Cleaning (SSPC-SP3): Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, by power tool chipping, descaling, sanding, wire brushing and grinding.
4. White Metal Blast Cleaning (SSPC-SP5): Removal of all visible rust, oil, grease, soil, dust, mill scale, paint, oxides, corrosion products and foreign matter by blast cleaning.
5. Commercial Blast Cleaning (SSPC-SP6): Removal of all visible oil, grease, soil, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter, except that staining shall be limited to no more than 33 percent of each square inch of surface area.
6. Brush-Off Blast Cleaning (SSPC-SP7): Removal of all visible oil, grease, soil, dust, loose mill scale, loose rust and loose paint.
7. Near-White Blast Cleaning (SSPC-SP10): Removal of all visible oil, grease, soil, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter, except that staining shall be limited to no more than 5 percent of each square inch of surface area.

3.3 Corrections and Cleanup

Upon completion, any damaged, de-laminated, or defaced coated surfaces shall be touched up, restored, and left in first-class condition. Any coated or finished surfaces damaged in fitting or erection shall be restored. If necessary, an entire wall shall be refinished rather than spot finished. Upon completion and prior to final acceptance, all equipment and unused materials accumulated in the coating process shall be removed from the site and any spillage or other misplaced coating material shall be removed in a manner which will not damage surfaces. Perform required repair and cleaning to the satisfaction of the ENGINEER. Cooperate and coordinate work with the work of other trades in the removal and replacement of hardware, fixtures, covers, switch plates, etc., as required for coating.

3.4 Surface Preparation

A. General

Prepare all surfaces scheduled to receive new coating systems as required to provide for adequate bonding of the specified coating system to the substrate material. For existing coated surfaces, hand wash with cleaner or product recommended by coating manufacturer to properly prepare existing surface and provide for bonding of coating specified to follow. Remove any loose,

peeling, or flaking coating or mildewed areas. Surface preparation minimums shall be as follows:

1. Exposed metal items, non-submerged, unprimed, non-galvanized both interior and exterior, including: piping, structural steel and all other metal items not otherwise specified, shall undergo surface preparation in accordance with SSPC-SP6, "Commercial Blast Cleaning".
2. Exposed metal items, shop primed, both interior and exterior including: piping, steel doors, steel ladders to be painted, and railings, and all other metal items not otherwise specified, shall undergo surface preparation in accordance with SSPC-SP1, "Solvent Cleaning"; SSPC-SP2, "Hand Tool Cleaning"; and SSPC-SP3, "Power Tool Cleaning" as may be required to remove grease, loose or peeling or chipped paint.
3. Metal items, unprimed or non-galvanized, continuously or intermittently submerged, both interior and exterior including: piping, structural steel and all other metal items not otherwise specified, shall undergo surface preparation in conformance with SSPC-SP10, "Near-White Blast Cleaning".
4. Stainless Steel: Non-submerged and submerged, exposed piping and fittings, both interior and exterior shall undergo surface preparation in accordance with SSPC-SP1, "Solvent Cleaning".
5. Polyvinyl Chloride (PVC): Non-submerged, both interior and exterior, process piping and plumbing, shall be lightly sanded prior to application of the specified coating system to follow.
6. Non-submerged Concrete: Clean all concrete surfaces of dust, form oil, curing compounds or other incompatible matter. Etch and prime if required by manufacturer for specified coating products to follow. Allow minimum 28-day cure of concrete prior to application of coating systems.
7. Concrete Masonry Units: Repair all breaks, cracks and holes with concrete grout. The surface must be free of dirt, dust, loose sand and other foreign matter. Brush clean. Allow minimum 28-day cure of concrete joint mortar and repair grout prior to application of coatings system.
8. Wood: Wood surfaces shall be thoroughly cleaned and free of all foreign matter with cracks, nail holes, and other defects properly filled and sanded to a fine finish. Wipe clean of dust.

9. Preparation of All Existing Coated Surfaces: Remove rough and defective coating film from material surfaces to be painted. Touch up with approved primer. Clean all greasy or oily surfaces to be painted with benzene or mineral spirits or degreaser before coating, or as recommended by manufacturer. Patch nicks and gouges in walls, sand to match wall finish.

3.5 Prime Coating

- A. Exposed Steel: Prime coat all exposed steel in accordance with SSPC PS 13.01 for epoxy-polyamide coating systems. Prime coats shall be applied following completion of surface preparation requirements as specified in paragraph 3.4.A.1 above.
- B. Galvanized Metal: After surface preparation specified above, prime galvanized metal items receiving paints as specified with Tnemec Series 66 Hi-Build Epoxaline or equal, verifying with manufacturer before application the compatibility with coatings specified to follow.
- C. Shop Primed Metal: Where indicated on the Drawings or coating schedule and following the surface preparation procedures specified in paragraph 3.4.A.2 above, the MANUFACTURER shall apply intermediate and topcoats of the specified paint system to shop primed metal. The SUPPLIER shall verify with the manufacturer(s) representative of the item(s) to be painted, before application, the compatibility of shop primers with the specified intermediate and topcoat coating systems.
- D. Non-Shop Primed Metal and Piping: Prime coat all exposed metal and piping, except stainless steel, received at job site following completion of surface preparation requirements as specified in paragraph 3.4.A.1 above. Prime paint in accordance with SSPC PS No. 13.01 for epoxy-polyamide primers. Epoxy-polyamide primers shall conform to the standards set forth in SSPC Paint Specification No. 22.
- E. Concrete Masonry Units: After surface preparation specified above, prime coat as specified in the coating schedule found elsewhere in the Specifications.
- F. Wood Surfaces: Following surface preparation specified above, prime coat exterior exposed wood surfaces with appropriate coating system as specified in the painting schedule.

3.6 Field Prime

Wherever shop priming has been damaged in transit or during construction, the damaged area shall be cleaned and touched up with field primer specified herein or returned to the shop for resurfacing and re-priming, at the ENGINEER's discretion. Metal items delivered to the job site unprimed shall be cleaned and primed as specified herein.

3.7 Application

- A. Thickness: Apply coatings in strict conformance with the manufacturer's application instructions. Apply each coat at the rate specified by the manufacturer to achieve the dry mil thickness specified. If material must be diluted for application by spray gun, build up more coating to achieve the same thickness as undiluted material. Correct apparent deficiency of film thickness by the application of an additional coat.
- B. Porous Surfaces: Apply paint to porous surfaces as required by increasing the number of coats or decreasing the coverage as may be necessary to achieve a durable protective and decorative finish.
- C. Blast-cleaned ferrous metal surfaces shall be painted before any rusting or other deterioration of the surface occurs. Blast cleaning shall be limited to only those surfaces that can be coated in the same working day.
- D. Coatings shall be applied in accordance with the manufacturer's instructions and recommendations, and this section, whichever has the most stringent requirements.
- E. Special attention shall be given to edges, angles, weld seams, flanges, nuts and bolts, and other places where insufficient film thicknesses are likely to be present. Use stripe coating for these areas.
- F. Special attention shall be given to materials which will be joined so closely that proper surface preparation and application are not possible. Such contact surfaces shall be coated prior to assembly or installation.
- G. Ventilation: Adequately ventilate enclosed rooms and spaces during painting and drying periods.
- H. Drying Time: Do not apply next the next coat until preceding coat is dry. Test non-metallic surfaces with a moisture meter. The manufacturer's recommended drying time shall mean an interval under normal condition to be increased to allow for adverse weather or drying conditions. Coating

manufacturer's representative shall verify by cure testing, complete cure of coatings systems used for immersion service.

3.8 Coating Schedule

Coating Schedule

<u>Item</u>	<u>Location</u>	<u>Material</u>	<u>Coating System</u>
Piping	Inside Pump Stations (exterior surface)	Steel	Coating System 203
Piping	Inside Pump Stations (exterior surface)	Ductile Iron	Coating System 100
Miscellaneous Metals	Pump Stations & Vaults (exterior surface)	Galvanized Steel	Coating System 101

- * *Where handrails are to be field welded, taper paint layers back from welded end. Leave each layer approximately 6 inches back from previous layer. Provide sufficient exposed length of railing as to not cause damage from field welding to shop prime/paint.*

NOTE: Fusion bonded epoxy [ANSI/AWWA C213] may be substituted for coal tar epoxy. Potable water epoxy, NSF approved, shall be used for all surfaces in contact with potable water.

END OF SECTION

SECTION 11000
EQUIPMENT, GENERAL

PART 1 GENERAL

1.1 Description

- A. The SUPPLIER shall provide all tools, supplies, and equipment to operate the packaged pump station. All equipment shall meet the pertinent specifications, codes, and standards provided in this section. All equipment must be secure in its final operating location upon delivery. The equipment shall be tested and in an operational state.
- B. The provisions of this section shall apply to all equipment specified except where otherwise specified or shown.

1.2 Reference Specifications, Codes, and Standards

- A. All equipment, products, and their installation shall be in accordance with the following standards, as applicable and as specified in each section of these specifications:
 - 1. American Society for Testing and Materials (ASTM)
 - 2. American Public Health Association (APHA)
 - 3. American National Standards Institute (ANSI)
 - 4. American Society of Mechanical Engineers (ASME)
 - 5. American Water Works Association (AWWA)
 - 6. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE)
 - 7. American Welding Society (AWS)
 - 8. National Fire Protection Association (NFPA)
 - 9. Federal Specifications (FS)
 - 10. National Electrical Manufacturers Association (NEMA)

11. Manufacturer's published recommendations and specifications
12. Washington Industry Safety and Health Act (WISHA)

B. The following standards have been used as references in this section of the Specifications.

ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250 and 800
ANSI B16.5	Pipe Flanges and Flanged Fittings, Steel, Nickel Alloy and Other Special Alloys
ANSI B46.1	Surface Texture
ANSI S12.6	Method for the Measurement of the Real-Ear Attenuation of Hearing Protectors
ANSI/ASME B1.20.1	General Purpose Pipe Threads (Inch)
ANSI/ASME B31.1	Power Piping
ANSI/AWWA D100	Welded Steel Tanks for Water Storage
AWWA C206	Field Welding of Steel Water Pipe
ASTM A48	Specification for Gray Iron Castings
ASTM A108	Specification for Steel Bars, Carbon, Cold-Finished, Standard Quality

1.3 Submittals

- A. The SUPPLIER shall furnish complete Shop Drawings for all equipment specified in the various sections with all piping, valves, and controls for review by the ENGINEER in accordance with Section 01300, Submittals.
- B. The SUPPLIER shall supply one complete set of special tools where necessary for the assembly, adjustment, and dismantling of the equipment. Tools shall be considered special if the OWNER does not have the particular tool(s) prior to owning this pump station. Tool brand shall be coordinated with the OWNER's tools and shall be manufactured by a recognized supplier of professional tools such as Snap-On, MAC, Matco, Proto, or equal.
- C. The SUPPLIER shall obtain and submit from the manufacturer a list of suggested spare parts for each piece of equipment. SUPPLIER shall also

furnish the name, address and telephone number of the nearest distributor for each piece of equipment. Spare parts shall be supplied by the SUPPLIER when indicated in the appropriate equipment specification sections.

- D. Where required by the individual equipment sections, the SUPPLIER shall submit to the ENGINEER a torsional and lateral vibration analysis of the equipment. Equipment shall be designed and constructed such that the natural frequency of the drive train is avoided by a minimum of 25 percent throughout the entire operating range. The analysis shall be performed by a specialist experienced in this type of work and approved by the ENGINEER. The specialist or their assigned representative who shall similarly be experienced in this type of work and who shall be approved by the ENGINEER shall visit the project site during startup and testing of the equipment to analyze and measure the amount of equipment vibration, certify that the operating frequency avoids the natural frequency by 25 percent, and make a written recommendation for keeping the vibration at a safe limit.

1.4 Quality Assurance

- A. The SUPPLIER shall demonstrate that all equipment meets the specified performance requirements. SUPPLIER shall provide the services of an experienced, competent, authorized service representative of the manufacturer of each item of major equipment, who shall visit the manufacturing site to perform the following tasks.
 - 1. Assist the SUPPLIER in the installation of the equipment.
 - 2. Inspect, check, adjust if necessary, and approve the equipment installation.
 - 3. Start-up and field-test the equipment for proper operation, efficiency, and capacity.
 - 4. Perform necessary adjustments during the test period until the equipment installation and operation are satisfactory to the ENGINEER.
 - 5. Instruct the OWNER's personnel in the operation and maintenance of the equipment. Instruction shall include step-by-step trouble shooting procedures with all necessary test equipment.
- B. The costs of all inspection, startup, testing, adjustments, and instruction work performed by said factory-trained representatives shall be borne by the SUPPLIER. When available, the OWNER's operating personnel will provide assistance in the field testing.

- C. Tolerances and clearances shall be as shown on the Shop Drawings and shall be strictly observed. Machine work shall in all cases be of high-grade workmanship and finish, with due consideration to the special nature or function of the parts.
- D. The type of finish shall be the most suitable for the application and shall be in accordance with ANSI B46.1.
- E. Unless otherwise noted, all equipment furnished shall have a record from the same manufacturer of at least 3 years of successful, trouble-free operation in similar applications.

PART 2 PRODUCTS

2.1 General Requirements

- A. At each high noise level location, where equipment produces noise exceeding 85 dBA at 3 feet or exceeding WISHA noise level requirements for operator safety, the SUPPLIER shall supply two pairs of high attenuation hearing protectors. The ear protectors shall meet the requirements of ANSI S12.6 and shall produce a noise level reduction of 25 dBA at a frequency of 500 Hz. The hearing protectors shall have fluid filled ear cushions and an adjustable, padded headband. The protectors shall be stored in a weatherproof, labeled, steel cabinet, furnished by the SUPPLIER and mounted in an approved location near the equipment producing the noise.
- B. Unless otherwise specified or shown, all welding shall be by the metal arc method or gas-shielded arc method as described in the American Welding Society's "Welding Handbook" as supplemented by other pertinent standards of the AWS. Qualification of welders shall be in accordance with the AWS Standards governing same.

In assembly and during welding, the component parts shall be adequately clamped, supported, and restrained to minimize distortion and for control of dimensions. Weld reinforcement shall be as specified by the AWS code. Upon completion of welding, all weld splatter, flux, slag, and burrs left by attachments shall be removed. Welds shall be repaired to produce a workmanlike appearance with uniform weld contours and dimensions. All sharp corners of material to be painted or coated shall be ground to a minimum of $\frac{1}{32}$ inch on the flat.

- C. All equipment shall be painted or coated in accordance with Section 09800 – Protective Coatings, unless otherwise indicated. Non-ferrous metal and corrosion-resisting steel surfaces shall be coated with grease or lubricating oil.

Coated surfaces shall be protected from abrasion or other damage during handling, testing, storing, assembly, and shipping.

- D. All equipment shall be boxed, crated, or otherwise protected from damage and moisture during shipment, handling and storage. All equipment shall be protected from exposure to corrosion and shall be kept thoroughly dry at all times.
- E. Each item of equipment shipped shall have a legible identifying mark corresponding to the equipment number shown or specified for the particular item.
- F. All equipment subject to vibration shall be provided with restrained spring type vibration isolators or pads per manufacturer's written recommendations.
- G. Shop fabrication shall be performed in accordance with the Specifications and the Shop Drawings approved by the ENGINEER.

2.2 Equipment Supports and Foundations

- A. All equipment supports, anchors, and restraints shall be adequately designed for static, dynamic, wind, and seismic loads. The design horizontal seismic force shall be the greater of that noted in the general structural notes or as required by the governing building code (10 percent of gravity minimum).
- B. Equipment foundations shall be as per manufacturer's written recommendations. All equipment shall be mounted as shown on the manufacturer's standard details unless otherwise shown or specified.
- C. Shop Drawings submitted to the ENGINEER for review in accordance with the requirements of Section 01300, Submittals, shall include calculations showing equipment anchorage forces and the capacities of the anchorage elements to be provided by the SUPPLIER.

2.3 Pipe Hangers, Supports, and Guides

All pipe connections to equipment shall be supported, anchored, and guided to avoid stresses and loads on equipment flanges and equipment.

2.4 Flanges and Pipe Threads

All flanges on equipment and appurtenances provided under this section shall conform to ANSI B16.1, Class 125 or B16.5, Class 150, unless otherwise shown. All pipe threads shall be in accordance with ANSI/ASME B1.20.1 and with requirements of Section 15000, Piping, General.

2.5 Bearings

- A. Bearings shall conform to the standards of the Anti-Friction Bearing Manufacturers Association (AFBMA).
- B. All field-lubricated type bearings shall be equipped with a hydraulic grease fitting in an accessible location and shall have sufficient grease capacity in the bearing chamber.
- C. All lubricated-for-life bearings shall be factory-lubricated with the manufacturer's recommended grease to ensure maximum bearing life and best performance.
- D. Except where otherwise specified or shown, all bearings shall have a minimum B-10 life expectancy of 5 years or 20,000 hours, whichever occurs first.
- E. Bearing housings shall be of cast iron or steel and bearing mounting arrangement shall be as specified or shown, or as recommended in the published standards of the manufacturer. Split type housings may be used to facilitate installation, inspection, and disassembly.
- F. Sleeve type bearings shall have a Babbitt or bronze liner.

2.6 Flexible Connectors

Flexible connectors shall be installed in all piping connections to engines, blowers, compressors and other vibrating equipment.

2.7 Gaskets and Packings

- A. Gaskets shall be in accordance with the requirements of Section 15000, Piping, General.
- B. Packing around valve stems and reciprocating shafts shall be of compressible material, compatible with the fluid being used. Chevron type "V" packing shall be Garlock No. 432, John Crane "Everseal" or equal.
- C. Packing around rotating shafts (other than valve stems) shall be "O" rings, stuffing boxes, or mechanical seals, as recommended by the manufacturer and approved by the ENGINEER.

2.8 Nameplates

Equipment nameplates of stainless steel shall be engraved or stamped and fastened to the equipment in an accessible location. Nameplates shall contain the manufacturer's name, model, serial number, size, characteristics, and appropriate data describing the machine performance ratings.

PART 3 EXECUTION

3.1 Couplings

The SUPPLIER shall have the equipment manufacturer select or recommend the size and type of coupling required to suit each specific application. Installation shall be per equipment manufacturer's printed recommendations.

3.2 Packaged Equipment

- A. When any system is furnished as pre-packaged equipment, the SUPPLIER shall coordinate all necessary space and structural requirements, clearances, utility connections, signals, and outputs with its subsuppliers.
- B. If the packaged system has any additional features other than specified, the SUPPLIER shall coordinate such features with the ENGINEER and furnish all material and labor necessary for a complete installation, as required by the manufacturer, at no additional cost to the OWNER.

END OF SECTION

SECTION 11100

PUMPS, GENERAL

PART 1 GENERAL

1.1 Description

- A. The provisions of this section shall apply to all pumps and pumping equipment except where otherwise indicated.
- B. Where two or more pump systems of the same type or size are required, the pumps shall be produced by the same manufacturer.

1.2 Submittals

- A. Submittals shall be furnished in accordance with Section 01300.
- B. Shop Drawings shall contain the following information:
 - 1. Pump name, identification number, and specification section number.
 - 2. Performance data curves showing head, capacity, horsepower demand, NPSH required, and pump efficiency over the entire operating range of the pump. The pump manufacturer shall indicate separately the head, capacity, horsepower demand, overall efficiency, and minimum submergence required at the design flow conditions and the maximum and minimum flow conditions. A family of performance curves at intervals of 100 rpm from minimum speed to maximum speed shall be provided for each centrifugal pump equipped with a variable speed drive.
 - 3. The limits on the performance curves recommended for stable operation without surge, cavitation, or excessive vibration.
 - 4. Assembly and installation drawings including shaft size, seal, bearings, anchor bolt plan, part nomenclature, material list, outline dimensions, and shipping weights.
- C. Complete motor nameplate data as defined by NEMA, motor manufacturer, and any modifications.
- D. Operation and maintenance manual containing the required information for each pump section.

- E. A spare parts list containing the required information for each pump section
- F. Signed, dated, certified factory test data for each pump system which requires factory testing submitted before shipment of equipment.
- G. Certifications
 - 1. Manufacturer's certification of proper installation
 - 2. SUPPLIER's certification of satisfactory field testing

PART 2 PRODUCTS

2.1 General

- A. Pumps Shall be Fairbanks Morse, Close-Coupled, single-stage end suction pumps or approved equal. Pumps shall have a 4-inch diameter suction flange and 3-inch diameter discharge flange. Pumps shall be Fairbanks Morse model number 3" 1654, or approved equal.
- B. Materials and equipment shall be standard products of a manufacturer and distributor regularly engaged in the manufacture and distribution of such products for at least two years and shall be suitable for the service intended. All materials and equipment shall be new and unused except for the testing specified herein.
- C. Compliance with the requirements of the individual pump sections may necessitate modifications to the manufacturer's standard equipment.
- D. All centrifugal pumps shall have a continuously rising performance curve. In no case shall the required horsepower at any point on the performance curve exceed the rated horsepower of the motor or engine or encroach on the service factor.
- E. All components of each pump system provided under the pump sections shall be entirely compatible. Each unit of pumping equipment shall incorporate all basic mechanisms, couplings, electric motors or engine drives, variable speed controls, and necessary mountings and appurtenances.
- F. The pump manufacturer shall have an authorized service and repair center or distributor located within a 150-mile radius of the project site. This distributor shall be responsible to maintenance throughout the warranty period and beyond.
- G. The pumps shall be warranted by the manufacturer for a minimum of one year from the date of installation.

- H. All materials and coatings coming in contact with potable water shall be ANSI/NSF Standard 61 approved.

2.2 Materials

- A. All materials shall be suitable for the intended application; materials not specified shall be high-grade, standard commercial quality, free from all defects and imperfections that might affect the serviceability of the product for the purpose for which it is intended, and shall conform to the following requirements:
 - 1. Cast iron pump casings and bowls shall be of close-grained gray cast iron conforming to ASTM A 48 - Gray Iron Casings, Class 30, or equal.
 - 2. Stainless steel pump shafts shall be Type 416 or 316. Miscellaneous stainless steel shall be of Type 316, except in a septic environment.
 - 3. Anchor bolts, washers, and nuts in non-corrosive applications shall be galvanized steel in accordance with the requirements of Section 5500, Metal Fabrications. Anchor bolts, washers, and nuts in corrosive service applications shall be stainless steel in accordance with that section.

2.3 Pump Components, General

- A. Flanges: Suction and discharge flanges shall conform to ANSI/ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings, Class 12, 125, 250, and 800 or B16.5 - Flanges and Flanged Fittings dimensions.
- B. Handholes: Handholes on pump casings shall be shaped to follow the contours of the casing to avoid any obstructions in the water passage.

2.4 Pump Appurtenances

- A. Nameplates: Each pump shall be equipped with a stainless steel nameplate indicating serial numbers, rated head and flow, impeller size, pump speed, and manufacturer's name and model number.
- B. Gauges: Provide and install pressure gauges as shown on the Drawings.
 - 1. All pumps (except sample pumps, sump pumps, hot water circulating pumps, and chemical metering pumps) shall be equipped with pressure gauges on the pump discharge. Pump suction lines shall be provided with compound gauges. Gauges shall be located in a representative location not subject to shock or vibrations in order to achieve true and accurate

readings. Isolation diaphragms shall be provided for all gauges except where pumping potable water.

2. Where subject to shock or vibrations, the gauges shall be wall-mounted or attached to galvanized channel floor stands and connected by means of flexible connectors.

2.5 Factory Testing

A. The following tests shall be conducted on each indicated pump system

1. Pump Systems: All centrifugal pump systems 10 hp and larger shall be tested at the pump factory in accordance with the American National Standard for Centrifugal Pump Tests(ANSI/HI 1.6) or the American National Standard for Vertical Pump Tests (ANSI/HI 2.6) as approved by ANSI and published by the Hydraulic Institute. Tests shall be performed using the complete pump system to be furnished, including the motor. For motors smaller than 100 hp, the manufacturer's certified test motor shall be acceptable. The following minimum test data shall be submitted:
 - a. Hydrostatic test data
 - b. A minimum of five hydraulic test readings between shutoff head and 25 percent beyond the maximum indicated capacity, recorded on data sheets as defined by the Hydraulic Institute.
 - c. Pump curves showing head, flow, bhp, efficiency, and NPSH requirements.
 - d. Certification that the pump horsepower demand did not exceed the rated motor hp beyond the 1.0 service rating at any point on the curve.
2. Acceptance: In the event of failure of any pump to meet any of the requirements, the SUPPLIER shall make all necessary modifications, repairs, or replacements to conform to the requirements of the Contract Documents and the pump shall be retested at no additional cost to the OWNER until found satisfactory.

PART 3 EXECUTION

3.1. Services of Manufacturer

- A. An authorized representative of the manufacturer shall visit the project site to witness the following and to certify in writing that the equipment and controls

have been properly installed, aligned, lubricated, adjusted, and prepared for operation:

1. Installation of the equipment
2. Inspection and adjusting the equipment
3. Startup and field testing for proper operation
4. Performing field adjustments to ensure that the equipment installation and operation comply with requirements

B. Instruction of the OWNER's Personnel

1. An authorized training representative of the manufacturer shall visit the project site to instruct the OWNER's personnel in the operation and maintenance of the equipment, including step-by-step troubleshooting with necessary test equipment. Instruction shall be specific to the models of equipment provided.
3. Training shall be scheduled a minimum of three weeks in advance of the first session.
5. The training materials shall remain with the trainees.
6. The OWNER may videotape the training for later use with the OWNER's personnel at its discretion.

3.2 Installation

- A. General: Pumping equipment shall be installed in accordance with the manufacturer's written recommendations.
- B. Alignment: All equipment shall be field tested to verify proper alignment. Operation shall be as specified and free from binding, scraping, vibration, shaft runout, or other malfunction. Pump drive shafts shall be measured prior to assembly to ensure correct alignment without forcing. Equipment shall be secure in position and neat in appearance.
- C. Lubricants: The SUPPLIER shall provide the necessary oil and grease for initial operation.

3.3 Field Tests

- A. Each pump system shall be field tested after installation to demonstrate satisfactory operation without excessive noise, vibration, cavitation, or overheating of bearings.

- B. The following field testing shall be conducted:
1. Startup: Check and operate the pump system over its entire speed range. Where vibration analysis and measurement is required, it shall be within the amplitude limits recommended by the Hydraulic Institute at a minimum of four pumping conditions defined by the ENGINEER.
 2. Obtain concurrent readings of motor voltage, amperage, pump suction head, and pump discharge head for at least four pumping conditions at each speed. Check each power lead to the motor for proper current balance.
 3. Determine bearing temperatures with a contact type thermometer. A run time of at least 20 minutes shall precede this test unless insufficient liquid volume is available.
 4. Electrical and instrumentation tests shall conform to the requirements of the section under which that equipment is specified.
- C. Field testing will be witnessed by the ENGINEER. The SUPPLIER shall give three days' advance notice to ENGINEER for field testing.
- D. If any pumping system fails to meet the test requirements, it shall be modified and retested as above until it satisfies the requirements.
- E. After each pumping system has satisfied the requirements, the SUPPLIER shall certify in writing that it has been satisfactorily tested and that all final adjustments have been made. Certification shall include the date of the field tests, a listing of all persons present during the tests, and the test data.
- F. The SUPPLIER shall bear all costs of field tests including related services of the manufacturer's representative. If available, the OWNER's operating personnel will provide assistance in field testing.

END OF SECTION

SECTION 11191

PACKAGED WATER PUMP STATION

PART 1 GENERAL

1.1 Scope

- A. Work covered in this section includes furnishing, installing, start-up, and operations training for package type, booster pumping station equipment.
- B. All equipment specified in this section shall be furnished by one SUPPLIER.

1.2 Reference Specifications, Codes, and Standards

- A. Corresponding Technical Specifications:
 - 1. Division 03 - Concrete
 - 2. Division 05 - Metals
 - 3. Division 06 - Wood and Plastics
 - 4. Division 07 - Thermal and Moisture Protection
 - 5. Division 08 - Doors and Windows
 - 6. Division 09 - Finishes
 - 7. Section 11000 - Equipment, General
 - 8. Section 11100 - Pumps, General
 - 9. Section 11230 - Horizontal End Suction Centrifugal Pumps
 - 10. Division 15 - Mechanical
 - 11. Division 16 - Electrical
 - 12. Division 17 - Instrumentation and Control
- B. Codes and Standards: Comply with the provisions of the following codes, standards and specifications, except as otherwise shown and specified:

AISC: "Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings", including "Commentary of the AISC Specifications"

AISC: "Specifications for the Design of Cold-Formed Steel Structural Members"

AWS: "Structural Welding Code"
- B. Welding of Aluminum: Conduct in accordance with Section 10 of the "Specifications for the Design and Construction of Structural Supports for Highway Luminaries", AASHTO, 1971. Welding method shall be either gas tungsten arc or gas metal arc. Rods shall be 4043.

C. Shop Assembly: Pre-assemble items in the shop to the greatest extent possible to minimize field assembly of units at the site. Disassemble units only to the extent necessary for shipping and handling limitations. Clearly mark units for re-assembly and coordinated installation.

D. Commercial Standards:

ANSI B16.5	Pipe Flanges and Flanged Fittings, Steel Nickel Alloy and other Special Alloys
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ANSI/ASME B1.20.1	General Purpose Pipe Threads (Inches)
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ASTM A 36	Specification for Structural Steel
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NEMA ICS 6	1988 (Rev. 1) Enclosures for Industrial Control and Systems
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NFPA 70	Current National Electrical Code
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SSPC-SP1	Solvent Cleaning
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SSPC-SP2	Hand Tool Cleaning
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SSPC-SP3	Power Tool Cleaning
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SSPC-SP6	Commercial Blast Cleaning
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ASTM A 125	Hot Dipped Galvanizing
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1.3 Submittals

The following must be submitted in addition to the requirements outlined in section 01300.

A. All information described in Section 00100, Instructions.

B. Information on any material or equipment listed in this section.

C. All applicable information relating the manufacture of this pump station.

D. Include delivery and installation methods. Include information on truck type, size, and owner.

1.4 Quality Assurance

A. Pumping Station Responsibility and Coordination

1. All equipment specified under this section shall be furnished by the pumping station SUPPLIER who shall be responsible for the adequacy and compatibility of all pumping station components. Any component of the complete pumping station not provided by the Manufacturer should be designed, fabricated, tested, and installed by factory-authorized representatives experienced in the design and manufacture of the pumping station equipment specified herein. This requirement, however, shall not be construed as relieving the SUPPLIER of the overall responsibility for this portion of the Work.
2. The SUPPLIER shall cause the pumping station Manufacturer and its suppliers to coordinate design of the pumping station such that all equipment is compatible and capable of achieving the performance requirements specified herein.

B. Design Requirements

The pumping station site and cross section arrangement shown in the Drawings is based upon the best information available to the ENGINEER at the time of design and is not intended to show exact dimensions particular to any specific equipment unless otherwise shown or specified. It is anticipated that the connected piping and valves shown, in part or in whole, may be modified in order to accommodate the specific pumping station furnished. No additional payment will be made for such modifications. All necessary calculations and Drawings for any related design shall be submitted to the ENGINEER for approval prior to beginning the Work.

The pumps shall be designed to operate without cavitation or damaging vibration over the entire specified range of flow and head conditions. The pumps shall not produce undue noise or vibrations during reductions in flow from the specified operating capacity range to zero flow.

1.5 Warranty

The SUPPLIER shall warrant the packaged pumping station to be of quality construction, free from defects in material and factory workmanship. The pump station structure shall be warranted for a period of twenty years to be free from defects, corrosion, or physical failures occurring in normal service, when installed in accordance with the MANUFACTURER's recommendations.

The interior equipment, pumps, motors, and apparatus shall be warranted for a period of one year, excepting only those items normally consumed in service, such as light bulbs, oil, grease, gaskets, or O-rings. The SUPPLIER shall be solely responsible for the pump station and all related components; warranties and guarantees by the suppliers of various components will not be accepted.

Major components which fail to perform as specified by the ENGINEER or prove defective in service during the warranty period shall be replaced, repaired, or satisfactorily modified by the SUPPLIER without cost of parts or labor to the OWNER. After start-up service has been performed, labor to replace accessory items such as blowers, heaters, light bulbs or other accessible and easily serviced parts shall be the responsibility of the OWNER. Such components, parts, or repairs determined to have failed because of defects in workmanship or materials will be replaced or repaired F.O.B. at factory or other designated location.

PART 2 PRODUCTS

2.1 General

The packaged pumping station shall include pumps, valving and piping, and other equipment identified in this section.

The packaged pump station shall be delivered to the jobsite requiring minimal additional fabrication or similar work, other than mounting on a concrete pad, connections to supply and discharge pipes, and electrical connections necessary for a fully functional unit.

Factory assembly of the packaged pump station shall include, but shall not be limited to, a coated steel or concrete base support system, pumps, motors, suction manifold, discharge manifold, shut-off valves, check valves, and all needed appurtenances. The pump starters and controls shall be mounted in a separate motor control center.

2.2 Experience Requirements

The packaged pump station shall be the product of a manufacturer who has the financial resources, technical qualifications, experience, organization, and facilities necessary to design and manufacture packaged pump stations of the type specified. The manufacturer shall have completed at least 25 prior successful installations of packaged pump stations similar in size and scope to the installation herein specified within the last five (5) years.

2.3 Pump Station Building

The pump station building shall be a factory-assembled modular structure. The building shall require limited assembly at the job.

A. Walls

1. The Exterior wall sheathing shall be ½-inch thick grade CCX plywood.
2. Interior wall and ceiling sheathing shall be ¾-inch thick grade CCX plywood.
3. The exterior wall finish of the pump station building shall be split-face concrete masonry unit or a panel or veneer finish with similar appearance. The color shall be selected by the ENGINEER.
4. Veneer panels used for the exterior finish shall meet the following requirements:
 - a. The station manufacturer shall apply at the factory prior to shipment fabricated veneer panels with an exterior wall stone in a block running bond grooved pattern of exterior face of exposed aggregate finish applied with polymer epoxy resin on mineral fiber reinforced cement board.
 - b. The aggregate finish shall be gray color. All material shall be obtained from one source to match in color as nearly as possible.
 - c. Epoxy resin finish shall conform to requirements of MIL Spec. MIL-R-9300B and MIL-R-21931A.
 - d. Mineral fiber reinforced cement board (M.F.B.) substrate shall meet the following minimum requirements:
 - 7000 lb/in² Compressive Strength
 - 2000 lb/in² Flexural Strength
 - 0.15 Thermal “R” Value
 - 0/5 Flame/Smoke Burn Character
 - e. Panel substrate and aggregate finish shall withstand the following tests without noted change in appearance or material failure:
 - 1000 hours in Atlas Twinarc weatherometer;
 - 14 cycles of salt, fog and thermal shock;
 - 100 cycles at -50 to +150 degrees F.
 - f. The panels shall be installed according to the manufacturers installation guide with the necessary accessories recommended by the manufacturer.
 - g. The manufacturer shall provide a five (5) year warranty from date of purchase against defective materials or workmanship.
 - h. Material shall be manufactured by Fullerton Finish Systems, Inc. Sand Springs, Oklahoma, or approved equal.
5. The interior wall finish shall be fiber-reinforced plastic paneling.

B. Roof

1. The roof of the pump station building shall be a gabled, standing metal seam roof. The roof shall have a single ridgeline in the center of each square section of the building. The slope of the roof shall be 1:3 unless noted in the approved submittal package. A covered entry shall be provided to be connected to the roof system. The roof system shall be a factory-assembled roof truss system and shall include sheathing, underlayment, and metal roofing as described in Division 07.
2. The truss system shall be covered by ½" thick C-C Grade plywood.
3. The roof panels shall be brought to the hip roof edges and capped with a double-paneled broken edge panel running the entire length of all four gable edges of the roof. The upper edge of the edge panel shall lap over and finish the standing seam roof panels.
4. The ridgeline of the roof shall be covered with a broken edge panel open along the sides to create a roof vent along both sides of the entire ridge line. The top of the broken edge panel along the ridge line shall cover over the top of the standing seams to provide a finished appearance.
5. The roof panels shall be counter-flashed around the peripheral edge of the roof at the eaves. The counter-flashing strips shall lap over the fascia material and the fascia material shall lap over the edges of the soffits to close the system.
6. Roof materials and construction shall also satisfy the requirements of Section 07400.

C. Base

1. The pump station shall be designed to fit the preliminary site layout. The pump station shall be designed to be set in place at the site. The methods of foundation construction and installation procedures are to be defined in the submittal package. Once approved by the ENGINEER, the SUPPLIER shall coordinate foundation construction and piping layout with the construction contractor.
2. All steel used in the base shall meet or exceed the requirements of ASTM A36. Steel used in hollow structural sections shall meet or exceed the requirements of ASTM A500, Grade B.
3. Base-to-slab connectors shall be designed to resist thrust forces.

4. Provisions for floor drains shall be included in the construction of the base. Required site work to accommodate the floor drains shall be coordinated with the ENGINEER and construction contractor.
 5. Where pipe passes through the station floor, that area of the floor shall be provided with a grout sleeve made of steel pipe with sufficient diameter to pass a pipe flange for the planned pipe size.
 6. If a steel skid underside is used, it shall be insulated with an isocyanurate foam insulating material meeting the provisions of Division 07.
- D. Doors: Doors, locks, and hardware shall satisfy the requirements of Division 08.
- E. Bridge Crane System
1. The building shall be provided with a complete bridge crane system for the handling of equipment. The system shall consist of a traveling bridge, a chain hoist, and a trolley. The supports for the bridge crane running beams shall be attached to the building structure at the height of the walls and shall be supported by structural steel and columns sufficient to fully support the bridge crane structure and any load lifted at any point within the building. The system shall provide a beam and trolley which extends through the doorway for lowering equipment exterior of the building.
 2. The hoist shall be rated for 2,000 pounds and a lift of no less than the building wall height. A Weston-type load brake shall be supplied that requires no lubrication. To minimize jamming and slipping, the hoist shall be supplied with hand wheel covers with guide slots. The chain shall be hardened. The hook shall be forged steel, equipped with a safety latch and swivel.
 3. The trolley shall be manufactured of high-quality rolled steel. The wheels shall be double-row ball bearing type for greater wear capacity. The bearings shall be pre-packed with lifetime lubricant and protected by dust covers. The trolley shall quickly adapt to a wide range of beams with the "Dial-Fit" collar system. The trolley beam shall be a W 4 x 13 flange steel beam conforming to ASTM A36 standards.
- F. Wrought Iron Fence and Gate – The Pump Station shall include a wrought iron fence and gate to surround the covered area at the entrance doors. This fence and gate shall completely surround the covered area used to park an emergency generator.

1. The wrought iron fence and gate shall be commercial panels fabricated of 1-1/2" wide by 1/8" thick punched channel rails and 3/4" square by 16 gauge thick pickets welded at each intersection. The top of each picket shall include a 6" welded quad finial.
2. Each panel, post and gate shall be dipped in electacoat rust inhibitor after final assembly to prevent corrosion and then powdercoated.
3. The wrought iron fence shall include a vertically hung, double swing gate with a locking mechanism. The doors shall lock together as well as include a mechanism to lock the gates to the slab.
4. The post and lock holes in the slab shall be coordinated with the construction contractor pouring the slab if the base of the wrought iron fence is not assembled at the manufacturing facility.

E. Building Design Criteria

1. The pump station building shall be designed for the following:
 - a. Wind load of 90 miles per hour
 - b. Ground snow load of 30 pounds per square foot
 - c. Seismic design for the requirements of Category D, Site Condition D as defined in the 2009 International Building Code.
 - d. Floor live load of 125 pounds per square foot
2. The building interior shall meet all clearances mandated by national standards below and around equipment for proper servicing, removal, and replacement of equipment.
3. The walls and roof of the pump station shall be insulated as necessary to meet appropriate building and energy codes. The insulation shall have an ASTM E-84 flame spread index of 25 and smoke developed of 450.

F. The building structure, substructure, bridge crane system, and means of attaching the building to the foundation slab shall be reviewed and stamped by a Professional ENGINEER registered to practice in Washington.

G. The complete packaged pump station shall bear a serialized State of Washington Department of Labor and Industries authorization label affixed to the inside of the entry door which indicates building acceptance pursuant to Factory-Built Housing and Commercial Structures, Chapter 296-150F WAC of the Washington State Building Code. The authorization label shall include the Washington State AP number UBC-3479 compliance and specially designated Washington State manufacturer's number. A photocopy of the authorization

label to be affixed to the pump station shall be forwarded to the ENGINEER prior to shipment of the station.

H. Safety Floor Matting

If finished floor surface is metal, the walkway areas shall be covered with a rubber drainage runner. The runner shall be medium duty, 1/2 inch minimum thickness of open slot design allowing fluids to drain under standing or walking surfaces. The runner shall have a tread design to promote sure footing. The underside of the runner shall have a raised knob design to permit aeration and drainage and to reduce runner fatigue. The runner shall not be glued to the floor.

I. UL Listing

The station MANUFACTURER shall be required to affix to the station an UNDERWRITERS LABORATORIES (UL) LABEL attesting to the compliance of the station equipment under the PACKAGED PUMPING SYSTEMS (QCZJ) UL Listing Category and/or INTERTEK TESTING SERVICES (ETL) LABEL attesting to the compliance of the station equipment under PACKAGED PUMPING SYSTEMS. The ETL label shall state the station conforms to UL STD 778 and is certified to CAN/CSA STD C22.2 NO. 108.

2.4 Pumps

- A. The packaged pump station shall contain end-suction centrifugal pumps, suitable for horizontal orientation meeting the requirements of Section 11000, Equipment, General and of Section 11230, Horizontal End Suction Centrifugal Pumps.

2.5 Piping

The packaged pump station shall be provided with suction and discharge manifolds constructed of fusion-bonded epoxy-coated Schedule 40 steel pipe sized as shown. Individual suction and discharge piping shall be sized by the MANUFACTURER to suit the pumps provided. All piping shall be fabricated with 125-pound flanged connections or plain ends as shown. Individual pump suction and discharge branches shall have isolation valves. All valves and fittings shall be rated for a service pressure of 150 psi. Suction and discharge manifolds shall be provided with pressure gauges. Weld-o-lets, ball valves, tubing and bleed valves shall be provided on suction and discharge manifolds as required to accommodate pressure gauges and field devices for monitoring and control.

All other piping shall meet the requirements of Section 15000.

2.6 Ball Valves

For piping of less than 3" size, ball valves shall be used. The ball valves shall meet or exceed ASTM Spec B124 No. C37700. The ball valves will be 2-piece forged brass body, blow out proof stem, TFE seats, TFE packing with adjustable stem packing gland. The valves will be NPT threaded pattern complete with lever operators. Maximum working pressure shall be 600 psi.

2.6 Check Valves

Each pump discharge shall be provided with a no-slam, full-flow silent check valve meeting the requirements of Section 15105.

2.7 Butterfly Valves

Each pump shall be supplied with two lug-style butterfly valves with locking lever. Valves shall be oriented to close bubble-tight for removal of a pump or control valve while the others remain in service. Butterfly valves shall meet the requirements of Section 15102.

2.8 Air Release

Each pump shall be equipped with an air release valve on the discharge, permitting air to escape to atmosphere during initial priming.

2.9 Pressure Gauges

Pressure gauges shall be mounted on the suction and discharge manifolds. Suction pressure gauge range shall be 0 to 100 psi, and discharge pressure gauge range shall be 0 to 160 psi. Bronze or brass stop cocks shall be provided for removal of gauges without shutting the system off. Pressure gauges shall meet the requirements for Section 15221.

2.10 Pump Control

Pump station electrical components, control system, and instrumentation are as specified in Division 16 and Division 17.

2.11 Spare Parts

A spare volute gasket, gland gasket, mechanical seal, shaft sleeve and case wear ring shall be provided for each size of pump provided.

2.12 Electrical and Controls

Electrical and control work within the pump station shall conform to Division 16 and Division 17.

2.13 Heating/Cooling Exhaust Unit

The unit shall be one-piece, wall-mounted, factory-assembled, pre-charged, prewired, tested and ready-to-operate. The unit shall have a limited warranty of 5-years on parts and 1-year on compressor. Capacity and EER certified in accordance with ANSI/ARI Standard 390-2003. Supplier shall include heat rise calculations with the Submittal for the pumps and motors showing that the HVAC unit is properly sized.

1. One (1) each exterior wall mounted, hard-wired;
2. Enclosed weatherproof casing constructed of 20 gauge galvanized steel, finished with baked-on polyester enamel paint;
3. One (1) washable filter;
4. Remote adjustable thermostat;
5. Refrigerant: 410A (HFC);
6. Minimum EER Rating: 9.00

Cooling Capacity	BTUH	Breaker size	CFM @ 0.2" ESP, (Max/Min)	Heater	Bard Manufacturing Part Number
4 Ton	47,000	30	1635/1400	15 KW	W48A1-C15BW

2.14 Dehumidifier

1. One (1) each
2. Min capacity 30 pints per 24 hours.
3. Compressor rated 115 volts, 60 Hz, 4.3 operating amps.
4. Min 106 CFM fan speed.
5. Min humidity range 35 to 80% RH, ambient temperature range of 41 to 95 F, Type R410 A refrigerant.
6. Washable filter.
7. Condensate piped direct to drain.
8. UL listed rubber cord.

2.15 Generator Receptacle Assembly

The pump station shall include a generator receptacle assembly to be connected to a portable generator. Specifications for the receptacle assembly are outlined in Section 16100.

PART 3 EXECUTION

3.1 Storage, Shipping, and Delivery

- A. At such a time as the station is complete in the factory but prior to final testing and shipment, the ENGINEER and OWNER shall be given a two (2) week notice of this testing date. At their discretion, the ENGINEER and/or OWNER shall be present to view the station and final testing so as to review the station for conformance to the contract drawings and specifications.

Any deficiencies noted during this acceptance testing shall be rectified during the visit where possible. Those deficiencies not correctable during the visit shall be noted and rectified within seven (7) working days and a notice of such rectification shall be forwarded to the ENGINEER signed by the Quality Assurance Manager and an officer of the station MANUFACTURER. Participation in the factory acceptance test is at the discretion of the OWNER and to be covered at the OWNER's expense.

- B. If the MANUFACTURER completes the station prior to the delivery date specified in the Purchase Agreement, the MANUFACTURER shall store the completed pump station at the MANUFACTURER's facility, unless OWNER, ENGINEER, and construction contractor approve shipping.
- C. The station shall be delivered by the SUPPLIER to the project site for installation. The station SUPPLIER is completely responsible for the condition and completeness of the station upon delivery. The installing contractor is responsible for providing equipment to lift and place the station. The station MANUFACTURER shall provide competent support personnel for installation operations.
- D. The OWNER and its agents reserve the right to reject the delivery of the station for apparent deficiencies or damage and to withhold acceptance of delivery until those damages or deficiencies are resolved in writing.

3.2 Pressure Testing

When the station plumbing is completed, the pressure piping within the station (including valves, pumps, control valves, and fittings), connections as make up the entire system shall be hydrostatically tested at a pressure of 150 psi or a pressure equal to the lowest test pressure rating of the equipment within the tested system, whichever is lesser pressure. The test pressure shall be applied for a minimum of 20 minutes, during which time all joints, connections and seams shall be checked for leaking. Any deficiencies found shall be repaired and the system shall be retested.

The results of this testing shall be transmitted in writing to the ENGINEER prior to shipment of the station and shall note test pressure, time at full pressure and be signed by the Quality Control Manager or test technician.

3.2 Station Start-up and Training

- A. After the packaged pump station is installed in the field, the pump station MANUFACTURER shall furnish competent personnel to start up and test the complete package system. An operational test, simulating service conditions, shall be given to check for excessive vibration, for leaks in all piping and seals, and for correct operation of all auxiliary equipment. All irregularities shall be corrected to the satisfaction of the ENGINEER.
- B. The MANUFACTURER shall furnish a written report to the ENGINEER which details the results of the testing and includes all records kept during the test. The MANUFACTURER shall also certify that the equipment has been correctly installed and lubricated, is properly aligned and is free from undue stress imposed by piping or anchor bolts, and has operated satisfactorily under the tests performed.
- C. Prior to delivery, the pump station MANUFACTURER shall furnish six copies of complete installation, operations, and maintenance manuals (O&MM), covering all equipment furnished. The O&MM shall be complete with an “as built” set for all drawings used in the project – mechanical, electrical and instrumentation as well as any other pertinent diagrams, schematics, details, emails or correspondence provided to the owner or the installing contractor during the project.

END OF SECTION

SECTION 11230

HORIZONTAL END SUCTION CENTRIFUGAL WATER PUMPS

PART 1 GENERAL

1.1 Description

Work covered in this section includes furnishing, installing, start-up and operation training for close-coupled horizontal end suction centrifugal water pumps.

1.2 Submittals

The information listed below shall be submitted to the ENGINEER for review in accordance with Section 01300. The submittal shall, as a minimum, include the following data drawings and other descriptive materials.

- A. AutoCAD shop drawings to describe and show pump construction and materials.
- B. Pump performance curves showing the head, capacity, speed, efficiency, and brake horsepower required when operating at specified conditions. Pump curves shall show a minimum of four points including shut-off head and maximum capacity.
- C. All pump motor information as outlined by this specification.
- D. AutoCAD electrical schematic and wiring diagrams showing wiring, controls, and terminals.
- E. Information on all pump station equipment outlined by this specifications.

PART 2 PRODUCTS

2.1 Pumps

The pump shall be a horizontally mounted, single stage, end-suction centrifugal water pump. The pump shall be designed for continuous operating service and shall be constructed as follows to meet the intended service. Pumps shall be Fairbanks Morse, Close-Coupled, single-stage end suction pumps or approved equal. Pumps shall have a 4-inch diameter suction flange and 3-inch diameter discharge flange. Pumps shall be Fairbanks Morse model number 3" 1654, or approved equal. The pump shall be

warranted for a period of one year after the “start-up” date. The pump shall meet the following design conditions:

- | | | |
|----|---------------------------------------|---------------------------------|
| a. | Number of Pumps: | 3 |
| b. | Minimum Design Capacity | |
| | i. Point A on Pump Curve: | 570 gpm at 128 feet TDH |
| | ii. Point B on Pump Curve: | 400 gpm minimum at 150 feet TDH |
| c. | Maximum Speed: | 1800 rpm |
| d. | Maximum Shut-off Head: | 175 feet |
| e. | Minimum Efficiencies at Design Points | |
| | i. Point A on Pump Curve: | 78 percent |
| | ii. Point B on Pump Curve: | 75 percent |
| f. | Minimum Motor Size: | 30 HP |

The pump casing shall be constructed of fine grain cast iron ASTM A48 Class 30. All casing sections shall have heavy wall thickness to provide long life under abrasive and corrosive operating conditions. Casing shall be capable of withstanding a hydrostatic pressure test of at least 125 percent of shutoff pressure or 150 percent of design head. All mating surfaces shall have register fits to ensure proper alignment. Piping connections shall be ASA 125# flat face drilled flange. Flange face surface finish shall be within a minimum of 250 micro-inches. Pump shall have bronze replaceable hub and suction wear rings. Impeller shall be stainless steel.

The pump backplate shall be constructed of ASTM A48 Class 30 grey iron. The pump shall be equipped with a double mechanical seal, John Crane Type 1 or 2.

The bearing frames shall be constructed of fine grain ASTM A48 Class 30 grey iron. The bearing frames shall be line bored for exact concentricity and be equipped with anti-friction style bearings. The bearings shall be either ball or roller style, properly sized to accommodate all thrusts, both mechanical and hydraulic, imposed upon them. The frames shall be designed for captured bearing positioning and shall not require any field axial adjustment. The bearings shall have a minimum calculated B-10 bearing life rating of 20,000 hours at the stated design condition. A complete bearing life stress and loading calculation shall be provided by the pump manufacturer to illustrate compliance with this requirement. Bearing lubrication shall be either grease or oil with proper provisions, drains, vents or reliefs to facilitate easy re-lubrication in the field. The pump end shall be connected to the bearing frame by a register fit ASTM A48 class 30 grey iron bracket.

The pump shafts shall be of AISI 1018 Low/Mild Carbon Steel. The shafts shall be accurately machined and polished and of sufficient size to transmit full driver output without excessive flexure or stressing. All steps in the shafts shall be radiused to

reduce stress concentrations. Shaft deflection shall not exceed 0.008 inch, measured at end of shaft when operating at the specified design conditions. A complete shaft stress analysis calculation shall be supplied by the pump manufacturer to illustrate conformance with this requirement. The shafts shall be protected by renewable bronze shaft sleeves which extend through the stuffing boxes. The stuffing box shall be integrally cast with a motor mounting bracket, and shall provide an adequate area for internal recirculation of the pumped fluid around the sealing medium. A tapped and plugged hole shall be provided for external flushing as required.

The pump casing shall be fitted with a case wear ring to minimize abrasive and corrosive wear to the casing. The wear ring shall be of the radial type, press fitted into the casing.

The motor, bearing frame and pump shall be mounted on a steel base.

2.2 Spare Parts

For each pump, provide the following spare parts: mechanical seal, set of gaskets and o-ring seals, shaft sleeve, complete set of keys, dowels and pins, complete set of bearings, impeller, case wear ring, and impeller wear ring. Provide one complete set of any special tools required to dismantle the pump.

2.3 Motors

Motors shall be premium efficiency, TEFC, induction style and inverter duty suitable for variable speed operations. Calculations shall be provided showing the bearing loading. Motors shall conform to Division 16 and the following requirements:

- A. Electric motor driven pumps shall be furnished with vertical solid shaft electric motors, design B, high thrust, squirrel cage, induction type having NEMA weather protected type I enclosures unless otherwise specified. Motors shall be suitable electrically and mechanically to efficiently and effectively drive pumps. Motors shall operate in accordance with these specifications.
- B. Unless specified otherwise, all materials, workmanship and tests shall conform with the applicable specifications to NEMA, IEEE, ASA and AFBMA.
- C. Motor frame shall be steel or cast iron, aluminum shall not be permitted. Motors shall be rated for operation at 460 VAC, 3 phase, 60 hertz, service factor of 1.15 or greater. Motors shall be 1,800 RPM maximum and operate at standard RPM's as required by the pump or equipment which they drive. Motors shall be rated for premium efficiency. Rated efficiencies shall be based on NEMA standards MG1-12.536 or standards imposed by the local electric utility, whichever is more restrictive.

- D. Motors shall be suitable for across the line starting and shall be able to start and accelerate the connected load to full speed with 90% of rated voltage at the motor terminals. Motors shall be capable of full load operation with voltage variations of +/- 10% and frequency variation of +/- 5%.
- E. Motors shall be suitable for variable speed operations and shall be designed to meet or exceed NEMA MG1 Part 31 requirements.
- F. Motor starting current shall not exceed 650% of motor full load current.
- G. Insulation system: All motors shall be provided with Class "F" or better insulation systems except that motor lead insulation may be class "B" or better. Completed windings, when tested in accordance with IEEE #57 shall show a thermal rating not less than 150 degrees for 30,000 hours of life.
- H. Windings shall be held firmly in stator slots to prevent coil shift. Stator windings shall be of high conductivity copper magnet wire. Completed stator windings shall be provided with a properly cured, uniform impregnation for mechanical rigidity, moisture resistance, and protection against winding failure from accumulation of foreign conductive matter. The completed insulation system shall be capable of withstanding phase to ground rms voltage of 600 volts continuous and 2,300 volts instantaneous.
- I. Rated temperature rise above 40 degrees C ambient temperature, at service factor load of 1.15 shall not exceed 90 degrees C.
- J. Motors shall be dynamically balanced to a maximum of .001 inches peak to peak amplitude.
- K. Motors shall be equipped with anti-friction type thrust and guide bearings. Angular contact thrust bearings shall be used. Bearings shall be of sufficient capacity to withstand all static and dynamic thrust loads, both momentary and continuous, imposed by the pump. Motor bearings shall be greasable and sized to withstand thrust loads and have a minimum B-10 life of 20,000 hours.
- L. Motor thrust bearings shall be oil lubricated. Oil lubrication systems shall provide optimum lubrication of bearings. Oil lubricated motors shall have visual level indicators and accessible fill and drain plugs.
- M. Motors shall be equipped with non-reverse mechanisms which shall limit maximum reversal to 10 degrees of rotation.
- N. Motors shall be equipped with extra large heavy-duty split type conduit boxes.

- O. Motor Nameplates shall include Manufacturer name, serial number, rated horsepower, service factor, frequency, phase, load voltage, full load amps, full load speed, design designation, locked rotor current and or designation, insulation class, temperature rise, ambient temperature, NEMA efficiency, and full load power factor.
- P. Motors shall be as manufactured by General Electric Company, US Motors, or approved equal.

PART 3 EXECUTION

3.1 Installation

The SUPPLIER shall furnish, install, test and adjust the pump in strict accordance with the manufacturer's recommendations. The manufacturer shall ensure proper installation and perform necessary tests to ensure that the pump is fully functional and operating as specified herein.

3.2 SUPPLIER shall provide vibration analysis per Section 11000 - Equipment, General.

END OF SECTION

SECTION 15000

PIPING, GENERAL

PART 1 GENERAL

1.1 Description

Work under this section applies to the furnishing and installation of package pump station piping. All work shall conform to the standard construction specifications except as modified herein. In the case of discrepancy, the more stringent provision shall apply.

1.2 Requirements

- A. The MANUFACTURER shall furnish and install all piping systems shown and specified, in accordance with the requirements of the Contract Documents. Each system shall be complete with all necessary fittings, hangers, supports, anchors, expansion joints, flexible connectors, valves, accessories, heat tracing, insulation, linings and coatings and testing to provide a functional installation.
- B. The piping shown is intended to define the general layout, configuration, routing, method of support, pipe size, and pipe type. The mechanical drawings are not pipe construction or fabrication drawings. It is the MANUFACTURER's responsibility to develop the details necessary to construct all mechanical piping systems, to accommodate the specific equipment provided, and to provide and install all spools, spacers, adapters, connectors, etc., for a complete and functional system.

1.3 Reference Specifications, Codes and Standards: Comply with the provisions of the following Codes, Specifications and Standards, except as otherwise shown or specified.

Commercial Standards

ANSI/ASME B1.20.1 Pipe Threads, General Purpose (inch)

ANSI B16.5 Pipe Flanges and Flanged Fittings, Steel Nickel Alloy and other Special Alloys

ANSI/AWWA C207 Steel Pipe Flanges for Water Works Service, Sizes 4 in through 144 in.

ANSI/AWWA C606 Grooved and Shouldered Joints

ANSI/AWS D1.1 Structural Welding Code

ASTM A 307 Specification for Carbon Steel Bolts and Studs, 6,000 psi Tensile

ASTM A 325 Specification for High-Strength Bolts for Structural Steel Joints

ASTM D 792 Test Methods for Specific Gravity and Density of Plastics by Displacement

ASTM D 2000 Classification System for Rubber Products in Automotive Applications

1.4 Submittals

- A. The SUPPLIER shall submit complete Shop Drawings and certificates, test reports, and affidavits of compliance, of all piping systems, in accordance with the Contract Documents and as specified in the individual piping sections. The Shop Drawings shall include all necessary dimensions and details on pipe joints, fittings, fitting specials, valves, appurtenances, design calculations, and material lists. The submittals shall include detailed layout, spool, or fabrication drawings which show all pipe spools, spacers, adapters, connectors, fittings, couplings, unions, and pipe supports necessary to accommodate the equipment and valves provided in a complete and functional system.
- B. All expenses incurred in making samples for certification of tests shall be borne by the SUPPLIER.
- C. The SUPPLIER shall submit as part of the Shop Drawings a statement from the pipe fabricator certifying that all pipes will be fabricated subject to a recognized quality control program.

1.6 Quality Assurance

- A. Inspection: All pipe shall be subject to inspection at the place of manufacture. During the manufacture of the pipe, the ENGINEER shall be given access to all areas where manufacturing is in progress and shall be permitted to make all inspections necessary to confirm compliance with the Specifications.
- B. Tests: Except where otherwise specified, all materials used in the manufacture of the pipe shall be tested in accordance with the applicable Specifications and

standards. Welds shall be tested as specified. The SUPPLIER shall perform all tests at no additional cost to the OWNER.

- C. Welding Requirements: All welding procedures used to fabricate pipe shall be prequalified under the provisions of ANSI/AWS D1.1. Welding procedures shall be required for, but not necessarily limited to, longitudinal and girth or spiral welds for pipe cylinders, spigot and bell ring attachments, reinforcing plates and ring flange welds, and plates for lug connections.
- D. Welder Qualifications: Skilled welders, welding operators, and tackers who have had adequate experience in the methods and materials to be used shall perform all welding. Welders shall be qualified under the provisions of ANSI/AWS D1.1 by an independent local approved testing agency prior to commencing work on the pipeline. Machines and electrodes similar to those used in the WORK shall be used in qualification tests. The MANUFACTURER shall furnish all material and bear the expense of qualifying welders.

1.7 Material Delivery, Storage and Protection

All piping materials, fittings, valves, and accessories shall be delivered in a clean and undamaged condition and stored off the ground, to provide protection against oxidation caused by ground contact. All defective or damaged materials shall be replaced with new materials.

PART 2 PRODUCTS

2.1 Performance Requirements

- A. Ductile Iron Pipe and Fittings: All ductile iron pipe shall conform to the current provisions of the American Water Works Association (AWWA)/American National Standards Institute (ANSI) C151/A21.51. Unless otherwise designated, ductile iron pipe shall be standard thickness Class 52 with cement mortar lining.
 - 1. Pipe and fittings shall be flanged or restrained mechanical joints, as shown on the Drawings or as specified
 - 2. Flanged pipe shall be flanged in accordance with AWWA/ANSI C115/A21.15 with Class 125 drilling and full-face gaskets equal to Garlock 3000 Blue Guard with Nitrile binder. All ductile iron pipe and fittings shall be cement-lined and seal-coated according to ANSI/AWWA C104/A21.4. The seal coat shall be coal tar. Fittings for ductile iron pipe shall conform to AWWA/ANSI C110/A21.10 or

AWWA/ANSI C153/A21.53. Rubber gaskets shall conform to AWWA/ANSI C111/A21.11. Fittings for push-on pipe shall be restrained mechanical joint.

- B. Welded Steel Pipe and Fittings: All welded steel pipe shall conform to the current provisions of AWWA C200 (Grade C, ASTM A283 steel plate). The pipe shall be heavy walled steel pipe. The wall thickness of welded steel pipe shall be ½ inch for 24-inch diameter and smaller unless shown otherwise on the Drawings. Pipe shall be furnished to the indicated outside diameter unless shown otherwise on the Drawings. Pipe shall be furnished with ends as shown on the Drawings or as required for the conditions of installation if not shown. Provide weldolets for taps where shown or required.

Steel fittings for pipe 24 inches in diameter and less shall be forged steel conforming to ANSI B16.9 and ASTM A234, Grade B. Mitered fittings will be permitted only where shown on the Drawings. Fabricated elbows 0-30 degrees shall be two-piece, 30-60 degrees shall be three-piece, and 60-90 degrees shall be four-piece unless shown otherwise on the Drawings. All steel fittings shall be of schedule or wall thickness to match the pipe wall thickness. Mitered fittings shall be fabricated in accordance with the dimensions as shown in AWWA C208 if dimensions are not shown on the Drawings.

Where design pressure is 150 psi or less, flanges shall conform to either ANSI/AWWA C207 Class D or ANSI B16.5 150-pound class. Where design pressure is greater than 150 psi, up to a maximum of 275 psi, flanges shall conform to ANSI/AWWA C207 Class E, Class F, or ANSI B16.5 150-pound class. Where design pressure is greater than 275 psi, up to a maximum of 300 psi, flanges shall conform to ANSI/AWWA C207 Class F. AWWA flanges shall not be exposed to test pressures greater than 125 percent of rated capacity.

Flanges for steel pipe 24 inches in diameter and less shall be welding neck or slip-on forged steel conforming to ANSI B16.5 and ASTM A181, Grade 1, flat-faced, as adjacent pipe and fittings may dictate. Slip-on flanges shall not be used adjacent to forged fittings unless the fitting is the long-tangent type.

Pipe shall be shop-fabricated to the extent possible. Any field welding shall conform to the current provisions of AWWA C206. Forged fittings shall be used for all line size laterals and tees unless otherwise shown on the Drawings. Field welds shall be lap-welded slip joint, welded inside and outside, double-butt weld joint, or butt strap joint.

The interior of all welded steel pipes shall be given a white-metal blast cleaning conforming to SSPC-SP5 by the pipe manufacturer and given the

protective coating specified hereinafter. Exterior of “wet” exposure piping shall be prepared per SSPC-SP5, white metal blast. Exterior of “dry” exposure piping shall be prepared per SSPC-SP10, near white metal blast. Exterior coating to be as described below.

Unless other linings or coatings are required elsewhere in the Specifications or on the Drawings, steel pipe shall be lined and coated as follows (confirm per ENGINEER):

Lining	Fusion-bonded epoxy lined, AWWA C213 or liquid epoxy lined, in accordance with AWWA C210
Coating (Exposed)	Per Section 09800
Coating (Buried)	Per Section 09800

Before starting fabrication, the SUPPLIER shall submit to the ENGINEER Shop Drawings for review. The Shop Drawings shall include a marking plan and details of standard pipe sections, special fittings, and bends. Dimensions, plate size, coating, and linings and other pertinent information shall be shown. The marking plan shall show the location of each pipe section and each special with each piece numbered or otherwise designated in sequence. All outlets and bends shall be attached on standard lengths of pipe or made up into special lengths so that, when installed, they will be located as indicated. The MANUFACTURER shall furnish the pipe fabricated and designated so that, when installed according to the marking plan, the location of all outlets and specials will correspond to the details of the Drawings. Each pipe and fitting shall be marked on the outside to indicate the class of pipe and location number on the marking plan. Calculations supporting collar, crotch plate, and other reinforcing sizes shall also be submitted. Fitting and reinforcing design shall conform to AWWA manual M11, latest edition.

- C. Copper Pipe and Fittings: Copper pipe, unless specified elsewhere, shall be Type “L”, hard drawn, conforming to ASTM B88. Copper pipe under floor slabs, underground or cast in concrete shall be Type “K”.

Connection of copper tubing to steel or other metallic piping shall be made using insulating couplings or fittings such as to provide complete electrical isolation. Care shall be taken that copper tubing or fittings are not permitted to come in to contact with steel or other metallic piping, reinforcing steel, or other steel at any location. Electrical checks shall be made between copper tubing and metallic elements to assure that isolation is maintained. Wherever electrical contact is demonstrated by such tests, the MANUFACTURER shall locate the point or points of contact and correct this condition.

- D. Polyvinyl Chloride (PVC) Water Pipe and Fittings: PVC pipe 4 inches and smaller shall be schedule 40, Type 1 Grade I normal impact PVC pipe conforming to ASTM D1785 and D2467 and shall be solvent welded.
- E. Flexible Tubing: Flexible plastic pipe shall be standard weight polyethylene thermoplastic tubing conforming to ASTM D-1248 Type 1, Class A, Category 4, Grade E5.

2.2 Couplings and Specials

A. Flexible Couplings

1. Flexible Couplings and Flanged Coupling Adapters: Flexible couplings or flanged coupling adapters, where shown on the Drawings or where required, shall be of the gasketed sleeve type with diameter to properly fit the pipe.

Flanged coupling adapters shall be Romac FCA501 or equal. Where flanged-to-plain-end connections are restrained, harness lugs or 90° eyebolts shall be used. Harness lugs shall be Romac 490 or equal. Eyebolts shall be ¾-inch high strength, low alloy steel meeting AWWA C111. SUPPLIER shall provide documentation certifying that eyebolts have the required strength.

Tie rods shall conform to ASTM A193 grade B7 with a minimum tensile strength of 125 ksi.

2. Flexible couplings for steel pipe and ductile iron pipe shall be provided where shown and shall be steel middle ring with steel followers. For exposed service, the coupling shall be lined with material equal to pipe lining material. Coupling shall be coated with primer compatible with the pipe painting system. For buried or inaccessible service, the coupling and bolts shall be epoxy coated and lined. Couplings shall be Dresser Style 38, Ford FICA series, Romac or Smith-Blair.
3. Flexible couplings for PVC pipe shall be Romac Model 501 or approved equal.
4. Flanged coupling adapters for steel piping shall be Dresser Style 128 or approved equal.
5. Couplings shall be assembled on the job in a manner to ensure permanently tight joints under all reasonable conditions of expansion

and contraction. Gasket and O-ring material to be as recommended by manufacturer for intended service.

6. All flexible couplings and flanged coupling adapters as shown on the Drawings shall be suitably harnessed or blocked. The flexible coupling harnesses shall be installed to allow the flexible coupling to be pushed clear of the joint and as detailed in the AWWA Manual M11, 2nd Ed. and approved by the ENGINEER. Flexible couplings shall have a center pipe stop where noted on Drawings. Flanged coupling adapters shall be harnessed as shown on Drawings and details. Flexible couplings and flanged coupling adapters shall be provided with stainless steel bolts where submerged.
7. All tie bolt diameters shall be designed using ASTM A7 or A373 steel. Design pressure shall be 150 psi.

B. Flanged Insulating Joints

Insulating flanged joints shall conform to the following specifications:

1. Flanged joints shall be assembled, lined, and coated in the shop. The joint assembly shall be delivered to the job site as a complete unit.
2. After assembly, the joint shall be tested for continuity. Electrical resistance between flanges and between each bolt and each flange shall be not less than 100,000 ohms.
3. Each complete insulating flange set shall include a full faced gasket, a full length insulating sleeve for each flange bolt, and two insulating washers and two steel washers for each bolt. Insulating sleeves and washers to be G-10 glass epoxy as manufactured by Accurate Plastics, Inc., or approved equal.
4. Gaskets shall be full face and conform to ANSI B16.21, suitable for the operating and test pressures of the pipe system. Gaskets shall be non-asbestos and non-phenolic compressed sheet packing with nitrile rubber binder. Gaskets shall be Garlock 3000, or equal.
5. Insulating washers shall be 3 mm ($\frac{1}{8}$ inch) thick G-10 epoxy glass. Insulating washers shall fit within the bolt facing on the flange over the outside diameter of the sleeve, grind as necessary. Insulating sleeves shall extend the full width of both flanges, except where one flange hole is threaded where the sleeve shall extend through one flange and the gasket.

6. Washers shall be cadmium plated steel where buried and stainless steel where submerged. Washers shall fit within the bolt facing on the flange, grind as necessary.
 7. The complete assembly shall have an ANSI/AWWA pressure rating equal to or greater than that of the flanges between which is installed.
- E. Where required, copper pipe to copper pipe connections shall be made with compression couplings. Couplings shall be Mueller Model 110 or approved equal.
 - F. Cast-In Wall Pipe: Cast-in wall pipe shall be cast ductile iron, or steel with pipe diameter and end types as shown on the Drawings.
 - G. Cast-In Wall Sleeve: Cast-in wall sleeves shall be fabricated from Schedule 40 galvanized steel pipe. The inside surface of all wall sleeves shall be coated with coal-tar. The annular space between the penetrating pipe and the wall sleeve shall be filled with an approved, permanently flexible sealant. Diameter of wall sleeve shall be as shown on the Drawings.
 - H. Cast-In Floor Pipe: Cast-in floor pipe shall cast ductile iron or steel pipe as required by the Drawings and the intended service conditions. Pipe diameter shall be as shown on the Drawings.
 - I. Cast-in-Floor Sleeves: Cast-in-floor sleeves shall be fabricated from Schedule 40 galvanized steel pipe. Sleeve diameter shall be as shown on the Drawings. The annular space between the penetrating pipe and the sleeve shall be filled with an approved permanently flexible sealant.
 - J. Cast-In-Wall Sleeve: Cast-in-wall sleeves for interior wall penetrations shall be fabricated from 16-gauge galvanized steel. Sleeve diameter shall be as shown on the Drawings. The annular space between the penetrating pipe and the sleeve shall be filled with an approved permanently flexible sealant.
 - K. Seep Rings: Seep rings shall be fabricated from $\frac{3}{8}$ -inch thick steel plate conforming to ASTM A36 unless otherwise noted. The inside diameter of the seep ring shall be equal to the outside diameter of the pipe or sleeve to which it is attached plus $\frac{1}{4}$ inch. The outside diameter of the seep ring shall be as shown on the Drawings. The seep ring shall be attached to the pipe or sleeve by means of a continuous seal weld located on both sides of the ring.
 - L. Flexible Expansion Joints: Flexible expansion joints shall be installed in the locations indicated on the Drawings and shall be manufactured from ductile

iron conforming to the material properties of ANSI/AWWA C153/A21.53. Flexible joints shall be provided with end connections as shown on the Drawings. All flexible expansion joints shall consist of an expansion joint designed and cast as an integral part of a ball and socket type flexible joint having a minimum of 15 degrees deflection per ball and 4-inches expansion. Actual expansion and deflection requirements will be as shown on the Drawings. Each flexible expansion joint shall be hydrostatically tested to the manufacturer's published pressure rating prior to shipment. All parts under pressure service shall be lined with a minimum of 15 mils of Fusion-Bonded Epoxy conforming to the applicable requirements of ANSI/AWWA C213 and shall be holiday tested with a 1500 volt spark test conforming to said specification. All flexible expansion joints shall be Flex-Tend as manufactured by EBAA Iron, Inc. or approved equal.

M. Flexible expansion joints for piping 2-inch diameter and smaller shall be Brass Flex-Tend manufactured by EBAA Iron, Inc. or approved equal.

N. Insulating Union

Where required, insulating unions shall conform to the following specifications:

Insulating unions shall be galvanized malleable iron with a ground joint. Iron pipe threads shall conform to ANSI B2.1. Joint connections to copper alloy pipe and tube shall be copper solder or threaded brass ground joints.

Insulations shall be nylon, which is bonded and molded onto the metal body. Unions shall be rated for the operating and test pressures of the pipe system.

2.3 Pipe Coatings

See Division 9, Finishes, for coating of exposed pipe.

PART 3 EXECUTION

3.1 General

Pipe shall be installed in accordance with good trade practice. The methods employed in handling and placing of pipe, fittings, and equipment shall be such as to ensure that they are in good condition after installation and testing. Should damage occur to the pipe, fitting, or equipment, repairs satisfactory to the ENGINEER shall be made. The backfilling of buried pipe is specified in Division 2.

All piping and appurtenances shall be installed to accurate lines, elevations, and grades as shown on the Drawings or specified herein. Where possible, piping shall be

sloped to permit complete drainage. Where grades are not shown, pipe shall be laid to grade between control elevations shown on the Drawings.

3.2 Pipe Supports and Hangers

- A. All pipe shall be secured in place by use of blocking, hangers, brackets, clamps, or other approved methods, and the weight thereof shall be carried independently of pump casings or equipment. Special hangers and supports are shown on the Drawings. The MANUFACTURER shall be responsible for determining the location of and providing all additional supports.
- B. Supports for exposed piping shall conform to the latest requirements of the ANSI Code for Pressure Piping B31.10 and MSS Standard Practice SP-58, except as supplemented or modified by the requirements of this specification. Designs generally accepted as exemplifying good engineering practice by use of stock or production parts shall be utilized wherever possible.
- D. Spacing of clamps for support of vertical piping shall be close enough to keep the pipe in alignment as well as to support the weight of the piping and contents unless other vertical support is shown, but in no case shall they be spaced farther apart than 12 feet.
- E. Provide adjustable hangers for all pipes, complete with adjusters, swivels, rods, etc. Size hangers to clear insulation and guide where required, as well as support piping. All rigid hangers shall provide a means of vertical adjustment after erection. Hanger rods shall be machine-threaded. Continuous threaded rods, also called "all-thread," will not be allowed.
- F. Clevis or band-type hangers (B-Line FIG B3100) or approved equal shall be provided by the MANUFACTURER. Strap hangers are not permitted.
- G. Provide floor stands, wall bracing, concrete piers, etc., for all lines running near the floors or near walls and which cannot be properly supported or suspended by the walls or floors. Pipe lines near concrete or masonry walls may also be suspended by hangers carried from wall brackets at a higher level than the pipe. Hanging of any pipe from another is prohibited.
- H. Equipment shall be positioned and aligned so that no strain shall be induced within the equipment during or subsequent to the installation of piping.
- I. When temporary supports are used, they shall be sufficiently rigid to prevent any shifting or distortion of the piping or related work.

- J. In erecting the pipe, a sufficient number of screwed unions or flanged joints shall be used to allow any sections or runs of pipe to be disconnected without taking down adjacent runs. Flexible couplings shall be installed where shown on the drawings and at such other points as may be required for ease of installation or removal of the pipe, subject to approval of the ENGINEER. Flexible couplings shall be of the positive lock type where necessary to prevent separation of pipe due to internal pressures.

END OF SECTION

SECTION 15075

ELECTROMAGNETIC FLOW METERS

PART 1 GENERAL

1.1 Description

The SUPPLIER shall furnish and install all meter and flow measurement devices with associated instrumentation and controls, complete and operable as shown on the Drawings and specified herein.

1.2 Reference Specifications, Codes, and Standards

Commercial Standards

ISA - S 5.1	Instrumentation Symbols and Identification
ANSI - B16.1	Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800
ANSI/AWWA C207	Steel Pipe Flanges for Waterworks Service - Sizes 4-inch Through 144-inch
AWWA C200	Steel Pipe Flanges for Waterworks Service
ASME Report	Fluid Meters, Sixth Edition, 1971

1.3 Submittals

- A. Shop Drawings: The SUPPLIER shall submit complete shop drawings of all meters, including associated wiring diagrams and electrical data as specified in the Contract Documents. Refer to Section 01300 for submittal requirements.
- B. Manufacturer's Data: With the Shop Drawings, the SUPPLIER shall also furnish certified curves indicating flow versus differential pressure and any other information called for in the individual meter specifications.
- B. Manuals: The SUPPLIER shall furnish to the OWNER, 2 copies of complete operation and maintenance instructions of all the metering systems including instrumentation and controls.
- D. Spare Parts: The SUPPLIER shall provide a list of manufacturer's recommended spare parts and after the ENGINEER's approval, shall furnish all spare parts suitably packaged and labeled for each meter device.

- E. Substitute Spool: A substitute steel spool with necessary end connections shall be provided for each meter for maintenance purposes. Each spool shall be labeled to identify the meter for which temporary replacement is required. The label shall include the meter identification number, size, and service.
- F. Special Tools: A list of special tools required shall be submitted to the ENGINEER for approval. After approval, the SUPPLIER shall supply these tools suitably wrapped and identified for application.

1.5 Quality Assurance

- A. Inspection and Testing Requirements: After installation, the SUPPLIER shall obtain the services of an experienced factory service representative to inspect, test, and certify all meters for proper performance and installation.
- B. Accuracy Requirements: Unless otherwise specified herein, the flow meters shall be guaranteed to register flow to an accuracy of within ± 2 percent of actual flow throughout the range specified.

1.6 Manufacturer's Service Representative

- A. Construction and Startup Assistance: During construction and startup, the SUPPLIER shall obtain all necessary assistance from an experienced factory service representative to ensure a correct installation in accordance with the manufacturer's instructions.
- B. Instruction of OWNER's Personnel: After completion of the installation and during startup, the SUPPLIER shall instruct the OWNER's personnel in the proper operation, maintenance, and repair of all metering equipment. The SUPPLIER shall obtain the services of an experienced factory service representative who shall spend sufficient time on site to fully instruct the OWNER's operating personnel to the OWNER's and ENGINEER's satisfaction.

PART 2 PRODUCTS

2.1 General

The SUPPLIER shall furnish and install flow meters, complete, as shown on the plans and specified herein, including appurtenances and accessories.

2.2 Magnetic Flow Meters

- A. The magnetic flow meter shall be microprocessor-based. It shall indicate, totalize, and transmit flow in full pipes. The magnetic flow meter shall use DC

bi-polar pulsed coil excitation, automatically re-zeroing after every cycle. The accuracy shall be ± 1 percent of rate over a 33:1 turndown at all flow rates above 0.1 meters per second (0.33 fps). Accuracy shall be verified by calibration in a flow laboratory traceable to the National Institute of Standards and Technology (NIST).

- B. The meter tube shall be steel and fitted with flanges conforming to AWWA Class 125 and ANSI Class 150 standards. The flow sensor liner shall be EPDM rubber. The sensor shall be submergence-proof to 5 meters and shall be NEMA 6 rated with FM, UL or CSA approval.
- C. The electronics shall be mounted remotely and the transmitter shall be submergence-proof and be NEMA 4X rated. The transmitter shall be furnished with a mounting bracket and cable (standard). Cable length shall be suitable for installation as shown on Drawings.
- D. The flow meter electrodes shall be 316 stainless steel.
- E. The use of grounding rings shall be as required by the manufacturer.
- F. Isolated current outputs shall be 4-20 mA dc plus two digital outputs. Signal converter shall also provide communications output conforming to HART protocol.
- G. Pulse output capability shall be provided. The unit shall have selectable pulse value and polarity and a maximum pulse width configurable from 0.5 to 2000 milliseconds.
- H. Unit shall provide for both analog and digital input signals.
- I. Switch points for low flow cutoff shall be provided and shall be adjustable.
- J. A minimum 16-character alphanumeric display shall be provided to indicate user-defined flow units and total flow. All menu advice and commands shall be viewed on this display. It shall not be necessary to remove covers, panels or fasteners to accomplish calibration or program changes.
- K. The flow meter shall have a power supply having an operating range from 85-260 Vac. 45/60 Hz.
- L. Flow meter shall be bi-directional. Display shall indicate flow direction and totalizer shall deduct volume on flow reversal.
- M. The flow meter shall be warranted against defective workmanship or materials for a period of two years from shipment date.
- N. Totalized flow and programmed configuration shall be maintained in memory for up to 10 years.

- O. The interior and exterior meter surfaces shall be epoxy coated in accordance with AWWA Standard C550.
- P. Acceptable flow meter manufacturer is McCrometer, or approved equal.

2.3 Meter Flow Ranges and Transmitter Type

Flow meter/Location	Number	Flow Range (to be verified during submittal review)	Transmitter
In Pump Station	1	0-2,500 gpm	Remote Mounted

PART 3 EXECUTION

3.1 Installation

The meter manufacturer's representative shall oversee the installation, adjustment, programming, testing, and calibration of each meter to ensure conformance with manufacturer's recommendations and the Contract Documents.

3.2 Testing

- A. Equipment shall be prepared for operational use in accordance with manufacturer's instructions, including bench testing and calibration, where required.
- B. Each item shall be subjected to an operating test over the total range of capability of the equipment. The SUPPLIER shall obtain copies of factory test certifications and shall notify the ENGINEER one week in advance of all tests to be conducted on site.

3.3 Acceptance by the OWNER

Final acceptance of the equipment is contingent on satisfactory operation after installation.

END OF SECTION

SECTION 15100

VALVES, GENERAL

PART 1 GENERAL

1.1 Description

- A. The SUPPLIER shall provide all tools, supplies, materials, equipment, and labor necessary for furnishing, installing, adjusting, and testing of all valves and appurtenant work, complete and operable, in accordance with the requirements of the Contract Documents.
- B. The provisions of this section shall apply to all valves and valve operators specified in Division 15 of these Specifications except where otherwise specified in the Contract Documents. Valves and operators in particular locations may require a combination of units, sensors, limit switches, and controls specified in other sections of these Specifications.

1.2 Reference Specifications, Codes, and Standards

A. Commercial Standards

ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800
ANSI B16.5	Pipe Flanges and Flanged Fittings, Steel Nickel Alloy and other Special Alloys
ANSI/ASME B1.20.1	General Purpose Pipe Threads (Inch)
ASTM A 36	Specification for Structural Steel
ASTM A 48	Specification for Gray Iron Castings
ASTM A 126	Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A 536	Specification for Ductile Iron Castings
ASTM B 61	Specification for Steam or Valve Bronze Castings

ASTM B 62	Specification for Composition Bronze or Ounce Metal Castings
ASTM B 148	Specification for Aluminum Bronze Castings
ASTM B 584	Specification for Copper Alloy Sand Castings for General Applications
ANSI/AWWA C500	Gate Valves for Water and Sewerage Systems
ANSI/AWWA C504	Rubber-Seated Butterfly Valves
AWWA C508	Swing-Check Valves for Waterworks Service, 2 Inches Through 24 Inches NPS
ANSI/AWWA C509	Resilient-Seated Gate Valves for Water and Sewerage Systems
ANSI/AWWA C511	Reduced-Pressure Principle Backflow-Prevention Assembly
AWWA C550	Protective Interior Coatings for Valves and Hydrants
SSPC-SP1	Solvent Cleaning
SSPC-SP3	Power Tool Cleaning
SSPC-SP6	Commercial Blast Cleaning

1.3 Submittals

- A. Shop Drawings: Shop Drawings of all valves and operators including associated wiring diagrams and electrical data, shall be furnished as specified in the Contract Documents and, if specified, in the individual valve sections.
- B. Valve Labeling: The SUPPLIER shall submit a schedule of valves to be labeled indicating in each case the valve location and the proposed labeling for the label.
- C. Lining and coating data
- D. Manufacturer's handling, delivery, storage, and installation requirements.

- E. Applicable material certifications and testing certifications and testing certificates.

1.4 Quality Assurance

- A. Valve Testing: Unless otherwise specified, each valve body shall be tested under a test pressure equal to twice its design water-working pressure.
- B. Bronze Parts: Unless otherwise specified, all interior bronze parts of valves shall conform to the requirements of ASTM B 62, or, where not subject to dezincification, to ASTM B 584.

PART 2 PRODUCTS

2.1 General

- A. Valve Flanges: The flanges of valves shall be in accordance ANSI B16.1, ANSI B16.5 and ANSI/AWWA C115/A21.15 as required. SUPPLIER shall coordinate with pipe, valve and fitting suppliers to make certain that pipe, valve and fitting flanges match in bolt pattern.
- B. Protective Coating: The valve manufacturer shall certify in writing that the required coating has been applied and tested in the manufacturing plant prior to shipment, in accordance with these Specifications. Flange faces of valves shall not receive protective coatings.
- D. Valve Operators: Valve operators shall be as shown or as specified for a valve type.
- E. Valve Labeling: A label shall be provided on all exposed shut-off valves exclusive of hose bibbs. The label shall be of $\frac{1}{16}$ -inch thick plastic or stainless steel, minimum 2 inches by 4 inches in size, and shall be permanently attached to the valve or on the wall adjacent to the valve as directed by the ENGINEER.
- F. Bolts, Gaskets, Glands and Nuts: Bolts, gaskets, glands, retainer glands, nuts and miscellaneous accessories required to install all valves shall be furnished and installed. Bolts and nuts for flanged connections shall be as specified elsewhere with American Standard regular unfinished square or hex heads. Gaskets for flanged connections shall be as specified elsewhere. Jointing materials for mechanical joints shall conform to AWWA C111.
- G. Actuators: Unless otherwise indicated, all valves and gates shall be furnished with manual actuators. Valves in sizes up to and including 4 inches in diameter shall have direct acting lever or handwheel actuators of the

manufacturer's best standard design. Larger valves and gates shall have gear-assisted manual actuators, with an operating pull of maximum 60 pounds on the rim of the handwheel. Actuators shall be sized for the valve design pressure in accordance with AWWA C504. All valves 6 inches to 30 inches in diameter may have traveling-nut actuators, worm-gear actuators, spur- or bevel-gear actuators, as appropriate for each valve.

PART 3 EXECUTION

3.1 Valve Installation

- A. General: All valves, gates, operating units and accessories shall be installed in accordance with the manufacturer's written instructions and as shown and specified. All gates shall be adequately braced to prevent warpage and bending under the intended use. Valves shall be firmly supported to avoid undue stresses on the pipe.
- B. Access: All valves shall be installed to provide easy access for operation, removal, and maintenance and to avoid conflicts between valve operators and structural members or handrails.
- C. Valve Accessories: Where combinations of valves, sensors, switches, and controls are specified, it shall be the responsibility of the Manufacturer to properly assemble and install these various items so that all systems are compatible and operating properly. The relationship between interrelated items shall be clearly noted on Shop Drawing.

END OF SECTION

SECTION 15101

GATE VALVES

PART 1 GENERAL

1.1 Description

The SUPPLIER shall furnish and install gate valves, complete and operable, as shown on the Drawings and specified herein, including coatings and linings, appurtenances, operators, and accessories, in accordance with the requirements of the Contract Documents.

1.2 Submittals

As required by Section 15100, Valves, General.

PART 2 PRODUCTS

2.1 General

Gate valves shall be furnished and installed as shown and as specified herein.

2.2 Materials and Manufacturers

A. Gate Valves, 2 Inches and Under

Unless specified or shown otherwise, gate valves two inches and under shall be bronze-bodied, non-rising stem, solid wedge disc type, as manufactured by Stockham, or approved equal and have a pressure rating appropriate for the design pressure.

B. Gate Valves, 3 Inches to 12 Inches

Gate valves for buried service shall be the resilient-seat type with an iron body, non-rising stem, bolted bonnet, left opening, and shall conform to AWWA Standard C509. Coatings and/or linings shall conform to AWWA Standard C550 and shall be suitable for potable water service. Valve ends shall be as shown on the Drawings. The SUPPLIER, as specified elsewhere, shall furnish a valve box and cover with all buried service valves installed. Gate valve stem extensions shall be furnished and installed on deep buried valves as specified in Section 15100, Valves, General.

Acceptable manufacturers are as follows:

1. Clow Resilient Wedge
2. M-H
3. U.S. Pipe Metro Seal
4. Kennedy Ken-Seal II
5. American Flow Control

C. Exposed Service

Gate valves for in-plant or exposed service shall meet the above specifications and shall be furnished with handwheel operators unless specified for outside screw and yoke. Valves 3 inches in diameter and smaller shall be Red and White 291 union bonnet or equal with ends as specified.

PART 3 EXECUTION

3.1 General

Gate valves shall be set in the ground vertically and shall be opened and shut under pressure to check operation. Valves shall show no leakage.

END OF SECTION

SECTION 15102

BUTTERFLY VALVES

PART 1 GENERAL

1.1 Description

The MANUFACTURER shall furnish and install butterfly valves, complete, as shown and specified herein, including coatings and linings, appurtenances, operators, and accessories, in accordance with the requirements of the Contract Documents.

1.2 Submittals

As required by Section 15100

PART 2 PRODUCTS

2.1 General

- A. Butterfly valves furnished under this section shall be of the rubber seated, tight-closing type. Metal-to-metal seating surfaces shall not be used. Butterfly valves shall be bubble-tight at the rated pressure with flow in either direction and shall be satisfactory for operation following long periods of inactivity. Valve discs shall rotate a full 90 degrees from the open position to closed position. Class 150 valves shall meet the full requirements of AWWA Standard C504 for Class 150B. Class 250 valves shall conform to the requirements of AWWA Standard C504 subject to the requirements herein.
- B. Valve shafts shall consist of the one-piece type or "stub-shaft" type. "Stub-shaft" type valve shafts shall be inserted a minimum of 1½ shaft diameters into the valve disk hub. Valve shafts shall have a minimum diameter extending through the valve bearings and into the valve disc as specified in AWWA Standard C504. Valve shafts shall be full size for that portion of the shaft extending through the valve bearings, valve disc, and shaft seal. Any portion of the shaft turned down for any reason shall have fillets with radii equal to the offset to minimize stress concentrations at the junction of the different shaft diameters. The turned down portion of the shaft shall be capable of transmitting the maximum operator torque without exceeding a torsional steel stress of 11,500 pounds per square inch (psi). Valve shafts shall be constructed of wrought stainless steel, model or carbon-steel, with stainless steel journals. When carbon-steel shafts and stainless steel journals are used,

static seals shall be provided to isolate the interior of the disc and the shaft from water.

- C. Valve discs shall be of cast design with no external ribs transverse to the flow. The design shall be such to sustain full differential pressure across the closed valve disc without exceeding a working stress to one fifth of the tensile strength of the disc material. Valve discs shall be constructed from cast iron, alloy cast iron, or ductile iron.
- D. Rubber seats applied to either the body or the disc shall be constructed from new natural or synthetic rubber secured to the valve body or disc and designed to provide tight shut-off and facilitate removal and replacement at the site. Rubber seats shall mate with the following acceptable surfaces: stainless steel, monel, bronze Grade A, D, or E, or alloy cast iron. Rubber seats that are applied to the valve body and are penetrated by the valve shaft shall be adequately reinforced and clamped, mechanically secured, bonded, or vulcanized to the valve body to prevent the seat from being inflated by pressure behind the valve seat. Rubber seats shall be resistant to microbiological attack, copper poisoning, and ozone attack. All clamps and retaining rings for rubber seats shall be corrosion-resistant.
- E. Valve bearings shall be of the sleeve type contained in the hubs of the valve body. Sleeve bearings fitted into the valve body shall be of self-lubricating materials approved for use with potable water.
- F. Valve shaft seals shall be designed for the use of standard split-v type packing, standard "O" ring seals or for pull down packing. "O" rings used for shaft seals shall be contained in a removable, corrosion-resistant recess. Shaft seals shall be designed to allow seal replacement without removal of the valve shaft.
- G. Valve operators shall conform to AWWA C504 and be of the manual type with handwheel operator unless specified otherwise below. Manual operators shall have all gearing totally enclosed and designed to produce the specified torque with a maximum pull of 60 pounds on the handwheel or chain wheel. Stop-limiting devices shall be provided in the operators for the open and closed positions. All operator components between the input and these stops shall be designed to withstand, without damage, a pull of 200 pounds for handwheel or chain wheel operators. All valves shall be equipped with adjustable mechanical stop-limiting devices to prevent over-travel of the valve disc in the open and closed positions.
- H. All surfaces of the valve shall be clean, dry, and free from grease before painting.

K. Acceptable Butterfly Valve manufacturers are as follows:

1. Pratt
2. M&H
3. Dezurik
4. Mueller
5. Or approved equal

2.2 Class 150 Butterfly Valves

- A. Valve bodies shall be constructed of cast iron conforming to ASTM A-126 Class B (with integrally cast flanged or mechanical joint ends). Flange drilling shall be in accordance with ANSI/B16.1 standard for cast iron flanges. Two trunnions for shaft bearings shall be integral with each valve body. Body thickness shall be in strict accordance with AWWA C504.
- B. Valve shafts shall be turned, ground, and polished. Valve shafts shall be constructed of 18-8 Type 304 or Type 316 stainless steel. Shaft diameters must meet minimum requirements established by AWWA C504 for Class 150B.

PART 3 EXECUTION

3.1 General

Valve installation shall be in accordance with Section 15100 and manufacturer's requirements. All valves 24 inches in diameter or larger shall be pressure and leakage tested at the project site and shall pass the field testing prior to installation.

END OF SECTION

SECTION 15105

CHECK VALVES

PART 1 GENERAL

1.1 Scope

The MANUFACTURER shall furnish and install swing and silent check valves complete, as shown on the Drawings and specified herein, including coating and lining, appurtenances, operators, and accessories.

1.2 Submittals

As required by Section 15100 and Section 01300.

PART 2 PRODUCTS

2.1 Materials

A. Swing Check Valves

1. Swing check valves (4-inch through 24-inch diameter): Swing check valves shall be full waterway, rubber- or metal-seated, with end conditions as shown on the Drawings. Swing check valves shall conform to all applicable provisions of AWWA C508. Swing check valves shall close tightly when the pressure downstream of the valve disc exceeds the upstream pressure.
2. Swing check valves shall be constructed of heavy cast iron conforming to ASTM A126 Class B; malleable iron castings conforming to ASTM A47 Grade 32510 or ASTM 197; ductile iron conforming to ASTM A395 or A536; or steel conforming to ASTM A108 or A307 Grade B. Swing check valves shall have bronze or composite rubber seat rings. The valve must be seat tightly, cause no shock, and absolutely prevent the return of water back through the valve. The body seat ring must be replaceable.
3. Swing check valve discs shall be constructed of cast iron or cast steel and shall be suspended from a non-corrosive hinge pin shaft constructed of stainless steel passing through a stuffing box. Swing check valves shall be furnished with NSF-approved epoxy lining and coating conforming to AWWA C210.

B. Silent Check Valves

1. The silent check valve shall be ANSI Class 125 and globe-style. The valves shall be of the silent operating type that begins to close as the forward flow velocity diminishes and be fully closed at zero velocity, totally preventing flow reversal and water hammer.
2. The valve design shall incorporate a center-guided, spring-loaded poppet, guided at opposite ends and having a short linear stroke that generates a flow area equal to the pipe. The valve interior shall be contoured and unrestricted to achieve maximum flow capacity and minimum pressure drop.
3. The operation of the valve shall not be affected by the orientation of installation. It shall be capable of operating in the horizontal or vertical position with the flow up or down.
4. All component parts shall be field-replaceable without the need for special tools. A replaceable guide bushing shall be provided and held in position by the valve's spring. The spring shall be designed to withstand 100,000 cycles without failure and exert a force which allows the valve to start opening at a differential pressure of 0.5 psi (0.04 kg/cm²) and to fully open at a flow velocity of 4 fps (1.22 meters per second).
5. The valve disc shall be concave to the flow direction providing for disc stabilization, maximum strength, and minimal flow velocity to fully open the valve.
6. The valve disc and seat shall be field-replaceable and have a seating surface finish of 32 micro-inch or better to ensure positive seating at all pressures. The leakage rate shall not exceed one-half of the allowable rate allowed by the AWWA C508, or 0.4 oz. (15 milliliters) per hour per inch (millimeter) of nominal valve diameter.
7. A Buna-N seal shall be furnished to provide zero leakage. The seal design shall provide for both a metal-to-metal seal and a metal-to-Buna-N seal to achieve resilient sealing at both low and high pressures without over loading or damaging the Buna-N seal.
8. Ends shall be flanged and be rated for a working pressure of 200 psi.

9. Valve shall be hydrostatically tested at 1.5 times the rated working pressure. Testing per AWWA, ANSI, MSS or API standards conducted when specified.

C. Manufacturers

1. Swing check valves 4 inches in diameter and larger shall be GA Industries, Inc. Fig. No. 220-D, Class 125, with flanged ends and lever and spring, or approved equal.
2. Swing check valves under 4 inches in diameter shall be red-white Toyo, or approved equal.
3. Silent check valves shall be Val-Matic 1800 series, or approved equal.
4. Dual disk check valves shall be Class 150 Crane Duo-Check II Valve, APCO S-9000 Double Door Check Valve, Val-Matic, or approved equal.
5. In-line check valve shall be of the slip-in type as manufactured by Tideflex Technologies.

D. Coatings

Furnish swing and silent check valves with liquid epoxy lining and coating conforming to AWWA C550.

PART 3 EXECUTION

3.1 General

Valve installation shall be in accordance with Section 15100 and manufacturer's requirements.

3.2 Services Provided by Manufacturer's Representatives

The SUPPLIER shall provide the services of the valve manufacturer's representative to verify proper installation of the valves and to adjust the valves when construction is complete.

END OF SECTION

SECTION 15112

PRESSURE SUSTAINING VALVES

PART 1 GENERAL

1.1 Description

The MANUFACTURER shall furnish and install pressure relief valve complete, as shown on the drawings and/or specified herein, including coating and lining, appurtenances, operators, and accessories.

1.2 Submittals

As required by Section 15100

PART 2 PRODUCTS

2.1 Reservoir Fill Valve

The packaged pump station shall include a 6-inch diameter pressure sustaining valve with solenoid control to regulate water to the reservoir. It shall be set to maintain a constant upstream pressure of 35 psi and include a solenoid override. The fill valve shall be a Cla-Val 6-inch diameter Combination Pressure Sustaining Solenoid Control Valve part no. 58DG-01BC w/ X105LCW Microswitch or approved equal.

2.2 Bypass Valve

The packaged pump station shall include 6-inch pressure relief / pressure sustaining valve to allow pressure from the pumps to circle back through the pump station. This valve shall be set to relieve pressures downstream of the pumps when pressures exceed 85 psi. The valve shall be a Cla-Val Pressure Relief/Pressure Sustaining valve, model no. 50G-01BV or approved equal.

2.3 General Guidelines for Pressure Relief Valve (3-inch and larger)

- A. Construction -- Valve shall be single seated, globe style, hydraulically operated and diaphragm actuated. Diaphragm assembly shall be guided top and bottom by a precision machined stem. Resilient valve disc, retained on three sides by disc retainers, shall form a drip-tight seal with a renewable seat when pressure is applied above the diaphragm. Control of valve operation shall be by means of an externally mounted, hydraulic pilot system.

Main valve body and cover shall be ASTM A48 cast iron or ASTM A536 ductile iron, with flanged ends. Main valve trim shall be bronze. Pilot control components shall be ASTM B61 bronze or ASTM B283 brass with Type 303 stainless steel trim, and pilot tubing shall be copper. Rubber parts shall be BUNA N synthetic rubber.

- B. Protective Coating -- Valve body and cover shall be lined and coated with an FDA approved fusion bonded epoxy coating system suitable for use with cast iron or ductile iron. The epoxy coating thickness and application shall be in accordance with AWWA C550.
- C. Pressure Rating -- Valve shall be suitable for a working water pressure of 200 psig.
- D. Operating Conditions -- The reservoir fill valve shall function properly with water supply to the pilot system of 20 to 75 psig pressure head. Flow through the valve shall be one-way. The pump bypass valve shall function properly with water supply to the pilot system of 20 to 200 psig pressure head.

E. Operating Requirements

Pressure Relief Control -- A pressure relief control, located in the pilot system, shall sense the main valve inlet pressure, and shall cause the main valve to modulate (open and close) as required to maintain a maximum pressure at the main valve inlet at all times. The desired maximum pressure shall be set by adjusting the spring force in the pressure relief control.

F. Accessories -- The following accessories shall be furnished with the valve.

1. Self-cleaning strainer for pilot system
2. Pilot system isolation valves on inlet, outlet, and cover lines
3. Opening speed control
4. Closing speed control
5. Valve position indicator
6. Limit switch on valve position indicator to signal when valve is open

G. Manufacturer -- Valve shall be manufactured by Cla-Val Co., Newport Beach, CA, or approved equal.

PART 3 EXECUTION

3.1 General

Valve installation shall be in accordance with Section 15100 and manufacturer's requirements.

3.2 Services Provided by Manufacturer's Representatives

The CONTRACTOR shall provide the services of the valve manufacturer's representative to verify proper installation of the valves and to adjust the valves when construction is complete.

END OF SECTION

SECTION 15113

COMBINATION SOLENOID SHUTOFF, PRESSURE REDUCING AND PRESSURE SUSTAINING VALVES

PART 1 GENERAL

1.1 Description

The MANUFACTURER shall furnish and install full port, hydraulically operated combination solenoid shutoff, pressure reducing and pressure sustaining diaphragm valves complete, as shown on the Drawings and as specified herein, including coating and lining, appurtenances, operators, and accessories. Valves shall be hydraulically actuated by line pressure and shall be capable of being closed by solenoid control.

1.2 Submittals

As required by Section 15100.

PART 2 PRODUCTS

2.1 Combination Pressure Reducing and Pressure Sustaining Valve

The valve shall be a Cla-Val Combination Pressure Reducing Pressure Sustaining valve, model no. 92G-07B DVY or approved equal.

2.2 General Guidelines

- A. Construction: Valve shall be single-seated, globe style, hydraulically operated and diaphragm-actuated. Diaphragm assembly shall be guided top and bottom by a precision machined stem. A resilient valve disc, retained on three sides by disc retainers, shall form a drip-tight seal with a renewable seat when pressure is applied above the diaphragm. Control of valve operation shall be by means of an externally mounted hydraulic pilot system.

The main valve body and cover shall be ASTM A48 cast iron or ASTM A536 ductile iron with flanged ends. Main valve trim shall be bronze. Pilot control components shall be ASTM B61 bronze or ASTM B283 brass with Type 303 stainless steel trim, and pilot tubing shall be copper. Rubber parts shall be Buna-N synthetic rubber.

- B. Protective Coating: Valve body and cover shall be lined and coated with an FDA-approved fusion bonded epoxy coating system suitable for use with cast iron or

ductile iron. The epoxy coating thickness and application shall be in accordance with AWWA C550.

- C. Pressure Rating: Valve shall be suitable for a working water pressure of 200 psig.
- D. Operating Conditions: Valve shall function properly with water supply to the pilot system of approximately 5 to 100 psig pressure head. Flow through the valve shall be one way.
- E. Operating Requirements
 - 1. Pressure Reducing Control: A pressure reducing control, located in the pilot system, shall sense the main valve inlet pressure, and shall cause the main valve to modulate (open and close) as required to maintain a maximum pressure at the main valve outlet at all times. The desired maximum pressure shall be set by adjusting the spring force in the pressure sustaining control. The pressure sustaining spring shall have a range of 0 to 100 psig.
 - 2. Pressure Sustaining Control: A pressure sustaining control, located in the pilot system, shall sense the main valve inlet pressure, and shall cause the main valve to modulate (open and close) as required to maintain a minimum pressure at the main valve inlet at all times. The desired minimum pressure shall be set by adjusting the spring force in the pressure sustaining control. The pressure sustaining spring shall have a range of 0 to 100 psig.
 - 3. Solenoid Shutoff Control: An electronic solenoid control shall cause the valve to close when activated.
 - 4. Position Indicator: An electronic position indicator shall be installed on the valve and connect to the OWNERS telemetry system.
 - 5. Check Feature: The valve shall include a check feature.
- F. Accessories: The following accessories shall be furnished with the valve:
 - 1. Self-cleaning strainer for pilot system
 - 2. Solenoid control valves with bypasses
 - 3. Pilot system isolation valves on inlet, outlet, cover and sensing lines.
 - 4. Pilot check valves
 - 5. Opening speed control.
 - 6. Closing speed control.
 - 7. Valve position indicator.

- G. Manufacturer: Valve shall be manufactured by Cla-Val Co., Newport Beach, CA, without exception.

PART 3 EXECUTION

3.1 General

Valve installation shall be in accordance with Section 15100 and manufacturer's requirements.

3.2 Services Provided by Manufacturer's Representatives

The SUPPLIER shall provide the services of the valve manufacturer's representative to verify proper installation of the valves and to adjust the valves when construction is complete.

END OF SECTION

SECTION 15221

PRESSURE GAUGES

PART 1 GENERAL

1.1 Description

The SUPPLIER shall furnish and install pressure gauges as specified below and as shown on the Drawings.

1.2 Submittals

As required by Section 01300

PART 2 PRODUCTS

2.1 General

Pressure gauges shall be bourdon tube type and shall have a 4.5-inch diameter dial and stainless steel case and ring. The gauges shall be stem mounted with a 1/4-inch NPT connection at the bottom of the case. The bourdon tube shall be bronze and the socket material shall be brass. All gauges shall be provided with a 1/4-inch NPT stop valve for isolation from the measured fluid. The pressure range shall be as shown on the Drawings or specified elsewhere. Pressure gauges shall be Ashcroft Model 1009 or approved equal.

END OF SECTION

SECTION 15222

PRESSURE TRANSDUCERS

PART 1 GENERAL

1.1 Description

The SUPPLIER shall furnish and install pressure transducers as specified below and as shown on the Drawings.

1.2 Submittals

As required by Section 01300, Submittals.

PART 2 PRODUCTS

Pressure transducers shall measure pressure and transmit a signal proportional to pressure or level and shall be the electronic variable capacitance, two-wire transmitter type. The instrument range shall be as noted on the Drawings or as specified elsewhere. The maximum adjustable range shall be such that the noted range shall lie between 40 percent and 80 percent of the maximum adjustable range. Accuracy shall be plus or minus 0.075 percent of span unless otherwise noted.

The instrument shall be capable of operation between -20 °F to 100 °F between 0 and 100 percent relative humidity. Wetted O-rings shall be glass-filled TFE, graphite filled-PTFE, or Viton unless otherwise noted. The instrument shall register gauge pressure, unless otherwise noted, and shall have an LCD display. Damping shall be accomplished by fluid or electronic type with adjustment. Wetted parts including process flanges and drain and/or vent valves shall be 316 stainless steel, unless otherwise noted. The housing shall be modular with separate compartments for electronics and field connections. Fill fluid shall be silicone unless otherwise noted.

The connection to the process shall be ½-inch diameter with a connection type as shown on the Drawings. The instrument shall provide a 4 to 20 mA dc output for load impedance of 0 to 500 ohms minimum without load adjustment with a 24 V dc supply. The enclosure shall be a NEMA 4X unless otherwise noted. The unit shall be mounted on the measured fluid pipeline as shown on the Drawings. Pressure transducers shall be Foxboro Model IGP10 or approved equal.

END OF SECTION

SECTION 16010

GENERAL ELECTRICAL REQUIREMENTS

PART 1 GENERAL

1.1 Description of Work

- A. The work consists of furnishing all labor, materials, services, tools, and other equipment necessary for the construction, installation, connection, and testing of all electrical work for this project as shown on the drawings or specified herein.
- B. The MANUFACTURER shall be responsible for the pump station building equipment layout including all enclosures, distribution equipment, package systems, panelboards, lights, receptacles and the like. The contract documents provided under this scope of work outline the general installation requirements of the entire project scope of work the MANUFACTURER shall be responsible.
 - 1. Investigate and be apprized of the applicable codes, rules, and regulations as enforced by AHJs.
 - 2. Use this Specification as a guide for workmanship and materials of construction. Utilize the design/build concept throughout the construction phase of the project.
- C. Costs/charges for installation of all permanent and temporary facilities shall be included in the lump sum bid for each of the pumping stations. This includes any up-front money required by the utility to provide permanent service.

1.2 Intent of Drawings and Specifications

- A. Riser and other diagrams are schematic only and shall not be used for obtaining quantities.
- B. The MANUFACTURER shall verify all site conditions.

1.3 Coordination of Work

- A. The MANUFACTURER shall verify all dimensions of equipment to be installed or provided by others so that correct clearances and connections may be made between the work installed by the MANUFACTURER and equipment installed or provided by others.
- B. The MANUFACTURER shall arrange all conduit runs so that they do not interfere with duct work, structural members, etc.

- C. All working measurements shall be taken from the sites, checked with those shown on the drawings, and if they conflict, reported to the ENGINEER at once, and before proceeding with the work. Should the MANUFACTURER fail to comply with this procedure, he shall alter his work at his own expense as directed by the ENGINEER.
- D. No extra payments will be allowed where obstructions in the work of other trades, or work under this contract requires offsets to conduit runs.

1.4 Supervision

- A. The MANUFACTURER shall maintain adequate supervision of the work and shall have a responsible person in charge during all times that work under this contract is in progress, or when necessary for coordination with other work.

1.5 Codes

- A. Work shall conform to the National Electrical Code (NEC), State codes and other applicable codes, even though not specifically mentioned for each item. These shall be regarded as the minimum standard of quality for materials and workmanship.

1.6 Workmanship

- A. All work shall be performed by personnel skilled in the particular trade. Workmanship shall conform to National Electrical Contractors Association Standard of Installation.
- B. The ENGINEER shall be the sole judge as to whether or not the finished work is satisfactory; and if in his judgment any material or equipment has not been properly installed or finished, the MANUFACTURER shall replace the material or equipment whenever required, and reinstall in a manner entirely satisfactory to the ENGINEER without any increase in cost to the Owner.
- C. The following shall be regarded as the minimum standard of quality for materials and workmanship even though not specifically mentioned for each item:
 - 1. Conform to requirements of the NEC, latest adopted version with amendments by local AHJs.
 - a. All work shall meet all requirements of the NEC for wet locations. All wiring methods shall conform to NEC requirements for Wet Locations.
 - 2. Furnish products listed by UL or other testing firm acceptable to AHJ.
 - 3. Conform to requirements of the serving electric, telephone, and internet utilities as they apply.

1.7 Drawings and Diagrams

A. Submit drawings showing:

1. Complete scale drawings of power, lighting and control systems layout. Show lighting system on separate drawings from power and signal drawings.
 - a. Provide adequate light within the building to monitor, operate, or maintenance all equipment within pump station building. Lighting shall provide the maximum amount of light possible while complying with the Washington Energy Code requirements.
 - i. Provide emergency egress lighting as required per code.
 - ii. Provide luminaires as specified in Division 16100 of the specifications.
 - iii. Provide light switches/controls near main entry/exit of pump station building.
 - b. Provide a minimum of (2) general purpose receptacles located a minimum of 15-feet apart from each other.
 - i. Locate electrical distribution, motor control and system control equipment within the building required for complete and functional operation of the pump station in a manner that meets all code clearance requirements. Layout of equipment shall be done in a manner that provides ease of access and use by station operators, maintenance staff or other authorized personnel.
2. Electrical distribution and branch circuit wiring systems for power and lighting.
3. Provisions for wiring of sensitive electronic equipment requiring independent grounding, special power circuit provisions and other necessary protective means for reliable power service.
4. Control system circuiting, diagrams and schematics, including process and instrumentation diagrams.
5. Branch circuit and sub-distribution panel circuit schedules with circuit designation and connected loads.

1.8 Record Drawings

- A. The MANUFACTURER shall maintain a neatly marked set of record drawings. In addition, the locations of panels, field mounted instruments and panels, terminal boxes, junction boxes and any other materials included in this contract shall be shown. Drawings shall be kept current with the work as it progresses and shall be subject to inspection by the ENGINEER at any time.

1.9 Controls System

- A. The control systems shall be provided as required by other sections of the specifications. In general, the control systems shall allow monitoring and control of the new pump station locally and through the City's existing SCADA system. All non-package system controls shall be provided by a single systems integrator.

PART 2 PRODUCTS

2.1 Materials

- A. Provide new electrical materials of the type and quality detailed, listed by UL, bearing their label wherever standards have been established. Indicated brand names and catalog numbers are used to establish standards of performance and quality. The description of materials listed herein governs in the event that catalog numbers do not correspond to materials described herein.
- B. Provide material and equipment that is acceptable to AHJ as suitable for the use indicated. For example, provide wet labeled equipment in locations that are wet.

2.2 Portable or Detachable Parts

- A. The MANUFACTURER shall retain in his possession and shall be responsible for all portable and detachable parts or portions of installations such as fuses, key locks, adaptors, blocking chips, and inserts until completion of his work.
- B. These parts shall be delivered to the ENGINEER and an itemized receipt obtained. This receipt, together with 2 copies of the final inspection certificate, shall be attached to the MANUFACTURER's request for final payment.
- C. All equipment shall be demonstrated to operate in accordance with the requirements of this specification and the MANUFACTURER's recommendation.

2.3 Rubber Matting

- A. Install rubber floor matting in front of all power distribution equipment, motor controller's and control panel's.
- B. Corrugated non-slip rubber mat of high dielectric strength and long aging qualities. Mat size, minimum of 36 inches wide extending the entire length of each power panel and control panel. Comply with ASTM Specification D178.24. 10,000 volt minimum dielectric strength, 3/16" thick.

2.4 Accessories

- A. Include special features, finishes, accessories, and other requirements as described in the Contract Documents regardless of the item's listed catalog number.
- B. Provide incidentals not specifically mentioned herein or noted on Drawings, but needed to complete the system or systems, in a safe and satisfactory working condition.

PART 3 EXECUTION

3.1 Examination

- A. Construction Documents:
 - 1. Drawings are diagrammatic with symbols representing electrical equipment and wiring.
 - 2. Electrical symbols indicating wiring and equipment shown in the Contract Documents are included in the Contract unless specifically noted otherwise.
 - 3. Examine the entire set of Drawings to avoid conflicts with other systems. Determine exact route and installation of electrical wiring and equipment with conditions of construction.
- B. Clarification:
 - 1. The Drawings govern in matters of quantity, the Specification in matters of quality. In event of conflict on Drawings or in the Specifications, the greater quantity and the higher quality apply.
 - 2. Should the Electrical Documents indicate a condition conflicting with the governing codes and regulations, refrain from installing that portion of the work until clarified by ENGINEER.

3.2 Protection During Construction

- A. Throughout this Contract, provide protection for materials and equipment against loss or damage in accordance with provisions elsewhere in these Contract Documents. Protect everything from the effects of weather.
- B. Prior to installation, store items in clean, dry, indoor locations. Store in clean, dry, indoor, heated locations items subject to corrosion under damp conditions, and items containing electrical insulation, such as transformers, and conductors. Energize all space heaters furnished with equipment.

- C. Following installation protect materials and equipment from corrosion, physical damage, and the effects of moisture on insulation. Cap conduit runs during construction with manufactured seals. Keep openings in boxes or equipment closed during construction. Energize all space heaters furnished with equipment.

3.3 Installation

- A. Install electrical equipment complete as directed by manufacturer's installation instructions. Obtain installation instructions from manufacturer prior to rough-in of the electrical equipment, examine the instructions thoroughly. When requirements of the installation instructions conflict with the Contract Documents, request clarification from ENGINEER prior to proceeding with the installation.
- B. Do not install electrical equipment in obvious passages, doorways, scuttles or crawl spaces which would impede or block the area passage's intended usage.
- C. Do not install outlet boxes back to back. Do not use straight through boxes.
- D. Support Backing:
 - 1. Provide any necessary backing required to properly support all fixtures and equipment installed under this contract.
- E. Cutting, Patching and Framing:
 - 1. The MANUFACTURER shall determine in advance the locations and sizes of all sleeves, chases, and openings necessary for the proper installation of his work.
 - 2. Whenever practical, inserts or sleeves shall be installed prior to covering work. Cutting and patching shall be held to a minimum. All required holes in concrete construction shall be made with a core drill and patched with non-shrink grout.
 - 3. Cutting, fitting, repairing and finishing of carpentry work, metal work, or concrete work, and the like, which may be required for this work shall be done by craftsmen skilled in their respective trades. When cutting is required, it shall be done in such a manner as not to weaken walls, partitions, or floors; and holes required to be cut in floors must be drilled without breaking out around holes.
- F. Cleaning and Touchup Painting:
 - 1. Keep the premises free from accumulation of waste material or rubbish. Upon completion of work, remove materials, scraps, and debris from

premises and from interior and exterior of all devices and equipment. Touch up scratches, scrapes, or chips in interior and exterior surfaces of devices and equipment with finishes matching as nearly as possible the color, consistency, and type of surface of the original finish.

3.4 Field Quality Control

A. Inspection

1. All materials, equipment, and workmanship shall be subject to inspection at any time by the ENGINEER, or his representatives. Correct work, materials, or equipment not in accordance with these Contract Documents or found to be deficient or defective in a manner satisfactory to the ENGINEER.

B. Tests:

1. Conduct tests of equipment and systems to demonstrate compliance with requirements specified in Division 16. Refer to individual Specification Sections for required tests. Document tests and include in Closeout Documents.
2. During site evaluations by ENGINEER provide an electrician with tools to remove and replace trims, covers, devices, and the like, so that a proper evaluation of the installation can be performed.
3. The MANUFACTURER shall furnish all labor, material, instruments and tools to make all connections for testing of the electrical and instrumentation installation. All equipment shall be demonstrated as operating properly prior to the acceptance of the work. All protective devices shall be operative during testing of equipment.
4. General:
 - a. Perform the tests as described below. Upon completion of all tests, submit written test results in duplicate for approval by the ENGINEER prior to acceptance.
 - b. After visual inspection of joints and connections and the application of tape and other insulating materials, all sections of the entire wiring system shall be thoroughly tested for shorts and grounds. A log of results for each circuit shall be kept by the MANUFACTURER and presented to the ENGINEER.
 - c. Equipment shall be tested by operating all electric motors, relays, controls, switches, heaters, etc. sufficiently to demonstrate proper installation and electrical connections. Control and emergency conditions shall be artificially simulated where necessary for complete system or subsystem.
 - d. Insulation resistance measurements of each circuit shall be made with loads connected and contactors, if any, blocked closed to give complete

circuits. Insulation resistance of complete circuit shall be measured from the circuit breaker load terminals with the breaker open. A log of complete results shall be prepared by the MANUFACTURER and presented to the ENGINEER. Values of resistance shall be 10 megohms or greater.

3.5 Cleaning

- A. Remove dirt and debris caused by the execution of the electrical work.
- B. Leave the entire electrical system installed under this Contract in clean, dust-free and proper working order.
- C. Vacuum clean interiors of electrical equipment enclosures.

END OF SECTION

SECTION 16100

BASIC MATERIALS AND METHODS

PART 1 GENERAL

1.1 Description of Work

The work consists of furnishing all labor, materials and equipment required for electrical work shown on the drawings and as further described in these specifications.

1.2 Regulations and Permits

- A. The MANUFACTURER shall comply with all applicable codes, ordinances, and regulations, including the National Electrical Code, National Electrical Safety Codes, and the State of Washington.
- B. The MANUFACTURER shall obtain a Certificate of Electrical Inspection from the local inspecting authority and submit to the OWNER upon completion of the project.

1.3 Submittals After Award of Contract

- A. Submittals after award of Contract shall be made in accordance with Section 01300, SUBMITTALS.

PART 2 PRODUCTS

2.1 Quality of Materials

- A. All contract materials shall be new, of proven quality, and without imperfections or blemishes. All material not specifically detailed in this specification required to accomplish the completion of this contract shall be of compatible quality to the item specified and be approved by the ENGINEER. All materials shall be products of manufacturers regularly engaged in production of such equipment and shall be of the manufacturer's latest design. Where 2 or more units of the same classes of equipment are required, these units shall be of the same manufacture. All material and equipment shall be per NEMA, ANSI, IEEE or ICEA Standards as applicable, except as modified by these specifications. All material shall be UL labeled as applicable.

2.2 Raceways

- A. All raceways shall be UL approved for the application.
- B. Rigid steel conduit -- Provide zinc-coated rigid steel conduit conforming to Federal Specification WW-C-581.
- C. Rigid intermediate steel conduit (IMC) -- Provide rigid intermediate steel conduit conforming to UL 1242 and Federal Specification WW-C-581.
- D. Flexible metallic conduit -- Provide liquid tight flexible conduit, zinc-coated steel core, extruded gray PVC cover, UL approved, Sealtite type "UA" or Liqueatite type "LA", or equal. Where permitted by local inspection authority, sizes larger than 3-inch shall be Sealtite type "EF", or Liqueatite type "LT", or equal.
- E. Rigid PVC conduit -- Provide rigid polyvinyl chloride (PVC) conduit, schedule 40, UL listed for concrete encased and direct burial underground. Rigid PVC conduit, including couplings, elbows and nipples, shall conform to the requirements of the latest edition of Federal Specification WW-C-1094, and NEC.

2.3 Conduit Fittings

- A. Provide conduit fittings as follows unless otherwise noted or detailed. Catalog numbers shown are RACO//Appleton Electric Company unless otherwise noted. Similar products of other manufacturers are equally acceptable.

Rigid Conduit Insulating Bushings	Series 1400//Series BBU
Rigid Conduit Set Screw Fittings	3010-3022, 3102-3116// Series SRNTC and SNTCC
Flexible Metallic Conduit Fittings	Pylets (Pyle-National)//Unilets
Expansion Joints	Adalet Type STR//OZ Type AX or TX
Conduit Wall Entrance Sealing	OZ Type FSK-GALV Fittings
Conduit Seal-Offs	OZ Type FSK-GALV

2.4 Outlet Boxes

- A. Provide outlet boxes as follows unless otherwise noted or detailed. Catalog numbers shown are Appleton Electric Company. Similar products of other manufacturers are equally acceptable.

Lighting Outlet Boxes (concealed)	No. 40-3/4
Same (concrete)	No. OCR Series
Same (exposed)	FS/FD Series
Same (exterior and damp locations)	As required by fixture
Switch, Receptacles, Telephone and Junction Boxes (flush)	No. 4S-3/4 with extension ring
Same (flush, limited space locations)	No. 225
Switch, Receptacles, Telephone and Junction Boxes (exposed)	FS/FD Series
Same (exterior and damp locations)	FS/FD Series with cast cover and gasket

- B. Provide extension rings as required and increase the above specified minimum box sizes to conform to allowable fill permitted by the code.
- C. For boxes installed in concrete or flush in walls or ceilings below finished grade, provide cast FS/FD series boxes.

2.5 Pull Boxes

- A. Provide code gage galvanized sheet steel pull boxes as shown on the drawings. Provide removable screw cover on the largest access side of the box unless otherwise detailed. Where cast boxes are indicated or specified, provide conduit entrances with threaded hubs. Provide stainless steel screws at all exterior and damp locations. Where pull boxes are required but not shown, provide pull boxes as specified above sized per NEC requirements.

2.6 Wiring Devices

- A. Provide wiring devices indicated. Catalog numbers shown are Bryant/Pass and Seymour, unless otherwise noted. Equal devices by other manufacturers may be substituted. All devices shall be submitted for approval. Provide all similar devices of same manufacturer unless indicated otherwise.

- B. Switches -- Provide flush switches, AC-type, rated 20 amp or higher suitable for the type load to be controlled.

Single-pole 4802-GRY/20AC1GRY

- C. Receptacles -- Provide grounding-type receptacles as follows:

Duplex 5262-GRY/6200 GRY

- D. Where indicated, provide receptacles with ground fault interrupter. Unit shall be furnished with internal, solid state, ground fault current sensing and tripping. The receptacles shall include built-in "TEST" and "RESET" switches and "TRIPPED" indicator and shall be rated 20-amp, 120-volt. The receptacles shall be UL approved. They shall be as manufactured by Pass and Seymour, 3M, Square D, or equal.
- E. The "GFI" receptacle shall be the "feed-thru" type and shall protect all receptacles on the same circuit.

2.7 Plates

- A. Provide plates for all wiring devices. Where devices are installed in exposed fittings or boxes, use Appleton, Pyle-National, Crouse-Hinds, or equal, "FSK" covers. Where weatherproof devices are specified on exterior or damp locations, use cast malleable covers with gasket and stainless steel screws. For devices in office interior locations provide plastic gray colored plate. Provide stainless-steel plates in all other finished areas.

2.8 Conductors

- A. This specification covers all conductors not specified in other sections. All conductors and cable shall conform to UL, Federal Specification J-C-30, or ICEA as applicable. Provide new cable manufactured within one year of installation.
- B. 600 volt power, lighting and control cable -- Provide stranded copper conductors unless otherwise specified, conforming to Federal Specification J-C-30. For cable type TW or THW, provide insulation conforming to Federal Specification J-C-30. FOR types THHN or THWN, provide insulation conforming to UL-83.

For type RHW and RHH, provide insulation conforming to ICEA S-19081.
For type XHHW, provide insulation conforming to ICEA S-66-524. Provide

neoprene jacket on RHW-RR type cables in accordance with ICEA S-19-81 specifications.

Provide control cable with 600 volt TW type insulation for all multi-conductor, Class 1 remote control and signal wiring unless otherwise specified. Provide overall jacket complying with ICEA S-61-402. Color code control cable in accordance with ICEA S-61-402, Table 5-1.

- C. Minimum conductor size -- Provide No. 12 AWG minimum branch circuit wire size. Provide No. 14 AWG control circuits unless otherwise specified or required by over-current protection. Provide smaller conductor sizes for specific application where shown on the drawings.
- D. Class 2 remote control and signal conductors -- Provide cables UL approved for such use. Voltage rating shall be not less than 600 volts. Utilize multi-conductor cables with like or related functions generally grouped together. Unless otherwise specified or shown on the drawings, utilize No. 14 AWG conductors.
- E. Instrumentation cables -- Multi-conductor cables shall have the quantity and size of conductors shown on the plans. Individual conductors shall be bare soft annealed copper Class B, 7-strand concentric per ASTM B-8. Individual conductor insulation shall be flame-retardant per UL 13, 15 mils nominal thickness, with a 105 degree C temperature rating. Conductor pairs shall be uniquely identified according to manufacturer's standard method. Overall cable assembly shall have 2.35 mils (minimum) aluminum-polyester tape shield overlapped for 100% coverage and provided with a 7-strand tinned copper drain wire the same size as an individual conductor. The jacket shall be flame-retardant per UL 13, with a 105°C temperature rating and a rip cord laid longitudinally under the jacket to facilitate removal. Conductors shall be twisted pairs and the cable shall be rated for operation to 300 volts.
- F. Twisted shielded pairs (TSP) shall be 7 or 19-strand, No. 18 AWG, tinned-copper conductors, 600 volt, individually insulated with color-coded cross-linked polyethylene, insulated conductors twisted into a pair, pair-shielded with a spirally applied aluminum/mylar tape shield and a 7-strand drain wire. Cable to have an overall 45 mil jacket.

2.9 Electrical Design, Assembly, and Test

- A. The electrical apparatus and control panel design, assembly, and installation, and the integration of component parts will be the responsibility of the MANUFACTURER of record for this booster pumping equipment. That MANUFACTURER shall maintain at his regular place of business a complete

electrical design, assembly and test facility to assure continuity of electrical design with equipment application. Control panels designed, assembled or tested at other than the regular production facilities or by other than the regular production employees of the MANUFACTURER of record for this booster pumping equipment will not be approved.

2.10 Conformance to Basic Electrical Standards

- A. The manufacturer of electrical control panels and their mounting and installation shall be done in strict accordance with the requirements of UL Standard 508A and the National Electrical Code (NEC), NFPA 70 latest revision so as to afford a measure of security as to the ability of the eventual OWNER to safely operate the equipment.
- B. No exceptions to the requirements of these codes and standards will be allowed; failure to meet these requirements will be cause to remove the equipment and correct the violation.

2.11 U.L. Listing

- A. All service entrance, power distribution, control and starting equipment panels shall be constructed and installed in strict accordance with Underwriter's Laboratories (UL) Standard 508A "Industrial Control Equipment." The UL label shall also include an SE "Service Entrance" rating stating that the main distribution panel is suitable for use as service entrance equipment. The panels shall be shop inspected by UL, or constructed in a UL recognized facility. All panels shall bear a serialized UL label indicating acceptance under Standard 508A and under Enclosed Industrial Control Panel or Service Equipment Panel.
- B. A photocopy of the UL labels for this specific project shall be transmitted the OWNER, ENGINEER, and the construction contractor for installation within their permanent project files, prior to shipment of the equipment covered under these specifications.

2.12 Nationally Recognized Testing Agency

- A. All control panels shall be approved by a nationally recognized testing agency that is also recognized by the state of Washington. A list of approved testing agencies can be found at <http://osha.gov/dts/otpc/nrtl/nrtllist.html>. Each completed panel shall bear a nationally recognized testing agency's listing label. The listing label shall include the station MANUFACTURER's name, address and telephone number. The station MANUFACTURER shall have quarterly inspections performed by the agency at the MANUFACTURER's

facilities to ensure that the products being listed comply with the report and procedural guide for that product.

2.13 Equipment Grounding

- A. Each electrical equipment item in the station shall be properly grounded per Section 250 of the National Electrical Code. Items to be grounded include, but are not limited to, pump motor frames, control panels, transformers, convenience receptacles, dedicated receptacles for heaters, air conditioners, dehumidifiers, lights, light switches, exhaust fans and pressure switches.
- B. All ground wires from installed equipment shall be in conduit and shall lead back to the control panel to a copper ground buss specific for grounding purposes and so labeled. The ground buss shall be complete with a lug large enough to accept the installing electrician's bare copper earth ground wire. The bus shall serve as a bond between the earth ground and the equipment ground wires.

2.14 Panel Mounting Hardware

- A. Metal framing channel and hangers shall be used exclusively for mounting of all electrical panels and electrical components except for those specifically designated otherwise.

2.15 Electrical Service

- A. The electrical service provided for this station will be 480 volt, 3-phase, 60 Hertz, 3 wire.

2.16 Electrical Distribution Panel

- A. The distribution panel shall be a single section, bolt-on panel board, bottom feed, surface mount, SE rated, NEMA 12 enclosure for three phase, three wire, 480 VAC Delta power and with copper bus. Panelboard and all circuit breakers shall be rated for 22 KAIC, minimum, but shall in no instance be rated for less than the calculated fault current as provided by the serving utility.
- B. The main circuit breaker shall be rated for 200 amp service.
- C. The distribution panel shall be complete with the following branch circuit breakers:
 - 1. One (1) 3-pole, 200 amp main breaker;
 - 2. Three (3) 3-pole, 80 amp domestic pump motor breakers;

3. One (1) 3-pole, 30 amp surge protection breaker
4. One (1) 3-pole, 15 amp phase monitor breaker;
5. One (1) 2-pole, 30 amp primary transformer breaker;
6. One (1) 3-pole, 30 amp HVAC breaker.
7. Two (2) 3-pole, 20 amp spare breakers.

D. Nameplates will be provided in etched phenolic, black with white letters.

2.17 Circuit Breaker and Control Panel

- A. All circuit breakers, motor starters, time delay relays and control relays shall be incorporated into one (1) NEMA 12 control panel.
- B. There shall be provided, thermal-magnetic trip circuit breakers as follows:
- C. Eight (8) Auxiliary Circuit Breakers, as follows:
 1. 1-pole, 20 amp Controls
 2. 1-pole, 20 amp Lights
 3. 1-pole, 20 amp Convenience Outlets
 4. 1-pole, 20 amp Dehumidifier
 5. 1-pole, 20 amp Telemetry
 6. 1-pole, 20 amp Lights
 7. 1-pole, 20 amp Spare
 8. 1-pole, 20 amp Spare

2.18 Electrical Apparatus – Adjustable Frequency Drives

- A. The adjustable frequency motor drive (AFD) shall consist of a pulse width modulated (PWM) inverter designed for use on a standard NEMA Design B induction motor.
- B. The AFD package shall be UL listed as a complete assembly and enclosed in an integrated UL type 1 enclosure, assembled and tested by the MANUFACTURER in an ISO9001 facility. The AFD tolerated voltage window shall allow the AFD to operate from a line of +10% nominal, and -15% nominal voltage as a minimum.
- C. All AFDs shall have the same customer interface, including digital display, and keypad, regardless of horsepower rating. The keypad shall be removable, capable of remote mounting and allow for uploading and downloading of parameter settings as an aid for start-up of multiple AFDs.

- D. The keypad shall include Hand-Off Auto selections and manual speed control. The drive shall incorporate bumpless transfer of speed reference when switching between Hand and Auto modes. There shall be fault reset and help buttons on the keypad. The Help button shall include on-line assistance for programming and troubleshooting.
- E. There shall be a built-in time clock in the AFD keypad. The clock shall have a battery backup with 10 years minimum life span. The clock shall be used to date and time stamp faults and record operating parameters at the time of fault. The clock shall also be programmable to control start/stop functions, constant speeds, PID parameter sets and output relays. The AFD shall have a digital input that allows an override to the time clock (when in the off mode) for a programmable time frame. There shall be four (4) separate, independent timer functions that have both weekday and weekend settings.
- F. The AFDs shall utilize pre-programmed application macros specifically designed to facilitate start-up. The Application Macros shall provide on command to reprogram all parameters and customer interfaces for a particular application to reduce programming time. The AFD shall have two user macros to allow the end-user to create and save custom settings.
- G. The AFD shall have cooling fans that are designed for easy replacement. Operating temperature will be monitored and used to cycle the fans on and off as required. The AFD shall be capable of starting into a coasting load (forward or reverse) up to full speed and accelerate or decelerate to setpoint without safety tripping or component damage (flying start).
- H. The AFD shall have the ability to automatically restart after an over-current, over-voltage, under-voltage, or loss of input signal protective trip. The number of restart attempts, trial time, and time between attempts shall be programmable.
- I. The overloading rating of the drive shall be 110% of its normal duty current rating for one (1) minute every ten (10) minutes, 130% overload for two (2) seconds. The minimum FLA rating shall meet or exceed the values in the NEC/UL table 430-150 for 4-pole motors.
- J. The AFD shall have an integral 5% impedance line reactors to reduce the harmonics to the power line and to add protection from AC line transients. The 5% impedance may be from dual (positive and negative DC buss) reactors, or 5% AC line reactors. AFDs with only one DC reactor shall add AC line reactors.

- K. The AFD shall include a coordinated AC transient protection system consisting of 4-120 joule rated MOVs (phase to phase and phase to ground), a capacitor clamp, and 5% impedance reactors.
- L. The AFD shall be capable of sensing a loss of load (broken belt/broken coupling) and signal the loss of load condition. Relay outputs shall include programmable time delays that will allow for drive acceleration from zero speed without signaling a false underload condition.
- M. If the input reference (4-20mA or 2-10V) is lost, the AFD shall give the user the option of either (1) stopping and displaying a fault, (2) running at a programmable preset speed, (3) hold the AFD speed based on the last good reference received, or (4) cause a warning to be issued, as selected by the user.
- N. The AFD shall have programmable Sleep and Wake up functions to allow the drive to be started and stopped from the level of process feedback signal.
- O. All AFD to have the following adjustments:
1. Three (3) programmable critical frequency lockout ranges to prevent the AFD from operating the load continuously at an unstable speed.
 2. Two (2) PID Setpoint controllers shall be standard in the drive, allowing pressure or flow signals to be connected to the AFD, using the microprocessor in the AFD for the closed loop control.
 3. Two (2) programmable analog inputs shall accept current or voltage signals.
 4. Two (2) programmable analog outputs (0-20mA or 4-20mA).
 5. Six (6) programmable digital inputs for maximum flexibility in interfacing with external devices.
 6. Three (3) programmable digital Form-C relay outputs.
 7. Seven (7) programmable preset speeds.
 8. Two (2) independently adjustable accel and decel ramps with 1 - 1800 seconds adjustable time ramps.
- P. The AFD shall include a motor flux optimization circuit that will automatically reduce applied motor voltage to the motor to optimize energy consumption and audible motor noise.
- Q. The AFD shall include a carrier frequency control circuit that reduces the carrier frequency based on actual AFD temperature that allows the highest carrier frequency without derating the AFD or operating at high carrier frequency only at low speeds.
- R. The AFD shall include password protection against parameter changes.

- S. The Keypad shall include a backlit LCD display. The display shall be in complete English words for programming and fault diagnostics (alpha-numeric codes are not acceptable). All applicable operating values shall be capable of being displayed in engineering (user) units. A minimum of three operating values shall be capable of being displayed at all times.
- T. The AFD shall have an RJ-45 port as standard. The supported protocols shall include Modbus, Modbus Plus, deviceNet, Ethernet TCP/IP, Profibus DP and Interbus-S. Each individual drive shall have the protocol in the base AFD. All protocols shall be certified by the governing authority. All communications capabilities shall include, but not be limited to; run-stop control, speed set adjustments, current limit, accel/decel time adjustments, and lock and unlock the keypad. The drive shall have the capability of allowing the DDC to monitor feedback such as process variable feedback, output speed/frequency, current (in amps), percent torque, power (kW), kilowatt hours (resettable), operating hours (resettable), and drive temperature. The DDC shall also be capable of monitoring the AFD relay output status, digital input status, and all analog input and analog output valves. All diagnostic warning and fault information shall be transmitted over the serial communications bus. Remote VFD fault reset shall be possible. The following additional status indicates and settings shall be transmitted over the serial communications buss - keypad Hand or Auto selected, bypass selected, the ability to change the PID setpoint. A minimum of 15 field parameters shall be capable of being monitored. The AFD shall allow the DDC to control the drive's digital and analog outputs via the serial interface. This control shall be independent of any AFD function.
- U. All AFDs shall include EMI/RFI filters. The onboard filters shall allow the AFD assemble to be CE Marked and the AFD shall meet product standard EN 61800-3 for the First Environment restricted level.
- V. All AFDs through 50 HP shall be protected from input and output power mis-wiring. The AFD shall sense this condition and display an alarm on the keypad
- W. The Adjustable Frequency Drive units shall be Motortronics MT Series, or approved equivalent.

2.19 Station Exterior Lighting

All building exterior luminaires shall have 90-degree full cut-off and shall be dark sky compliant. Provide wall mount compact fluorescent with injection molded polycarbonate, UV resistant cover and cast aluminum back plate. Luminaire shall have dark bronze finish and electronic ballast. Provide with integral photocell.

2.20 Station Interior Lighting

- A. Provide wet location rated, linear fluorescent T8 or T5 luminaires for general indoor lighting. Luminaire shall have fiberglass housing and high impact lens with white finish. Each luminaire shall have (2) lamps and a 0-degree electronic ballast. Luminaires shall be controlled by a double pole, single throw switch located at any entrance or exit.
- B. Emergency Exit Signs: Exit luminaires shall be universal mount, LED exit sign with NI-CAD battery and precision molded thermoplastic housing. Housing shall be scratch-resistant, corrosion-proof and UV stabilized to resist discoloration.
- C. Open fluorescent or incandescent fixtures will not be accepted.

2.14 Manual Transfer Switch

- A. A double throw switch shall be furnished to transfer the electrical load from one supply to another. Terminals shall be suitable for 75 degrees Celsius, Cu wire.
- B. The manual transfer switch shall have a lockable door hasp along with a lockable handle. The manual transfer switch interlocking mechanism shall be integrated with the access door. The mechanism shall prevent connections from being energized unless the access door is closed.
- C. The transfer switch shall be non-fusible, 3 pole, 600 VAC, 400 amp. The manual transfer switch shall be in a NEMA 12 enclosure and UL listed.
- D. Transfer switch shall be suitable for service entrance use with neutral or ground lug kit installed.
- E. The manual transfer switch shall be a model DT365UDK as manufactured by Cutler Hammer.

2.15 Receptacle Assembly

- A. A generator receptacle shall be furnished to supply power to the station during outages. The generator receptacle shall be rated 3-phase, 3-wire, 4-pole, 600 VAC, 200 amp, 50-400 hertz. The generator receptacle shall have a NEMA 4 rating. Generator Receptacle shall be dirt tight, dust tight, moisture resistant and be weather proof housing. Receptacle shall include weather proof self closing spring door. Receptacle shall be electro galvanized aluminum acrylic

painted ferrous iron alloy. Receptacle plug shall be Powertite ADJA20034-200 as manufactured by Appleton Electric, Co., or approved equivalent.

- B. Receptacle assembly shall consist of a black box with angle adapter and reverse service connector. Provide with matching plug, Powertite AP20034E, or approved equivalent.

PART 3 EXECUTION

3.1 Conduit Installation

- A. Provide rigid steel conduit for raceways embedded in structural reinforced concrete; in hazardous areas; in exposed locations; for sizes 1-1/4-inch and larger; and at all locations not otherwise specified.
- B. Provide flexible metallic conduit connections at all motors and transformers plus other equipment connections subject to vibration. Utilize suitable fittings, keep routes neat, at nominal right angles, and in conformance with equipment lines.
- C. Exposed conduit shall be run in straight lines parallel to column lines, walls, or beam. Where conduit is grouped, the bends and fittings shall be installed to present an orderly appearance. Unnecessary bending or crossing shall be avoided.
- D. Supports for exposed conduit runs shall be furnished and installed within 3 feet of each box. Supports shall be secured by means of expansion inserts in concrete.
- E. Conduit and fittings shall be properly protected during the construction period against mechanical injury from any cause. Conduit which extends out of floors, walls or slabs shall be boxed or otherwise protected and ends shall be capped with metal pipe plugs.
- F. Rigid conduit joints and connections shall be made thoroughly watertight and rustproof by means of thread compound which will not insulate the joint. Each threaded joint shall be thoroughly cleaned to remove all the cutting oil before the compound is applied. Running threads will not be allowed. Erickson couplings may be used in dry and exposed locations provided that they are installed with fixed threaded connection at the top of vertical runs.
- G. Size -- Use raceways no smaller than 3/4-inch except that 1/2-inch or larger may be used for switch legs; and control circuit wiring specified to be No. 14 AWG wire.

- H. Raceways in plain concrete -- Do not place raceways in cement toppings on structural floors without special approval. Install, however, in non-reinforced concrete headers and similar locations provided for their installation and in cement fill on precast concrete roofs.
- I. Raceways in reinforced concrete -- Do not displace reinforcing steel to accommodate the installation of raceways and outlet boxes. In general, locate all embedded conduits in the physical center of the particular section of concrete. Wooden plugs inserted in concrete or masonry is not acceptable as a base for raceway fastenings. Provide raceways embedded in reinforced concrete in conformance with the following usual types of conditions unless otherwise instructed by the Engineer. Particular attention is called to the fact that there are many extenuating conditions where the Contractor may be instructed during the course of the project not to place embedded conduits in certain areas, generally due to the possibility of unsightly cracking or for structural reasons. This instruction does not entitle the Contractor to extra compensation. Special approval will be required for any condition not covered by the following usual conditions.

<u>Location</u>	<u>Maximum Allowance</u>
Columns	Displacement of 4% of plan area of column
Floors and walls	Displacement of 1/3 of thickness of concrete, spaced not less than three diameters o.c.
Beams and joists	Displacement of 1/3 of least dimension, spaced not less than three diameters o.c.
Sleeves through floors and walls	Two-inch maximum pipe size, not less than three diameters o.c.

- J. Raceways entering the facility below grade -- Provide raceways with galvanized cast iron wall entrance seals having a watertight sealing gland assembly.

3.2 Wire and Cable Installation

- A. Conduit shall be thoroughly cleaned of all foreign material just prior to pulling the wire or cable. Lubricants shall be compounds specifically prepared for cable pulling and shall not contain petroleum or other products which will affect cable insulation. Lubrications shall be UL approved.

- B. Splicing of conductors No. 8 AWG or smaller shall be by pre-insulated spring-pressure connectors, such as "Scotchlok" Types Y, R and B, Ideal "Wingnut" or equal. All uninsulated splices, joints and free ends of conductors shall be covered with rubber and friction tape or high-dielectric strength, plastic tape. All splices in underground boxes or direct buried shall be insulated and waterproofed, using scotchcast epoxy splicing compounds suited for the purpose.
- C. Terminal strips in panels shall be identified throughout the equipment utilizing a unique numbering system.
- D. Wires terminating on terminal strips shall be tagged with the designation of the terminal strip and the number of the terminal to which they are connected. Wires shall be numbered with Brady nylon wire markers at all accessible locations. Wire markers shall be permanent type. Submit shop drawings of the type to be used for approval.
- E. Wiring diagram shall show the terminal strips, terminals, and their identifying designations.
- F. Color code

1. All secondary service, feeder, and branch circuit conductors shall be color coded as follows:

<u>480/277 Volt</u>	<u>Phase</u>
Brown	A
Orange	B
Yellow	C
Neutral	Gray

<u>240/120 Volt</u>	<u>Phase</u>
Black	A
Red	B
White	Neutral

<u>24 Volt DC</u>	
Blue	(+)
Yellow	(-)

2. All No. 12 and No. 10 branch circuit conductors shall have solid color compound or solid color coating. All neutral sizes shall have solid color compound or solid color coating.

3. No. 8 AWG and larger phase conductors shall have either
 - a. Solid color compound or solid color coating.
 - b. Stripes, bands, or hashmarks of colors specified above.
 - c. Colored pressure-sensitive plastic tape. Tape shall be applied in half overlapping turns for a minimum of 3 inches for all terminal points, and in all junction boxes, pull boxes, troughs, manholes, and handholes. Tape shall be 3/4 inch wide with colors as specified above. The last two laps of tape shall be applied with no tension to prevent possible unwinding. Where cable markings are covered by tape, apply tags to cable stating size and insulation type.

- G. Installation -- Keep all conductors within the allowable tension limits during installation. Lubricants for wire pulling, if used, shall be approved for the insulation and raceway material. Observe cable manufacturer's and industry standard cable bending radius recommendations. For type THHN/THWN conductors, avoid abrasion and damage to outer jacket. Wiring showing damage after installation shall be replaced.

- H. 600 volt conductors -- Provide one of the conductor types indicated for the function and location listed below unless otherwise indicated on the drawings or approved by the Engineer. Provide ground and neutral wires identical to circuit wires.

- I. Observe code restrictions with respect to wet and dry locations. At the Contractor's option, conductors with insulation systems rated for high operating temperatures may be substituted for lower temperature rated conductors. However, no reduction in conductor size will be permitted from that indicated. When using small diameter wire, do not reduce conduit size below that required for Type THW as shown in NEC Table 3A.

<u>Location</u>	<u>Insulation Type</u>	
	<u>THW, THWN, THHN</u>	<u>XHHW</u>
Lighting circuits, interior		
General	x	
Special fixture requirements	x	
Within 3 inches of ballast	x	
Receptacle and single-phase	x	
Motor circuits		
Interior	x	

<u>Location</u>	<u>Insulation Type</u>	
	<u>THW, THWN, THHN</u>	<u>XHHW</u>
Polyphase motor circuits		x
Motor controls	x	
Power outlets		x
Feeders		x
Underground-in raceway		x

J. Wire Pulling:

1. Provide suitable installation equipment to prevent cutting or abrasion of conduits during pulling of feeder.
2. Ropes used for pulling feeders shall be made of suitable non-metallic material.
3. Attach pulling lines for feeders by means of either woven basket grips or pulling eyes attached directly to the conductors, as approved by the Engineering.
4. All cables in a single conduit shall be pulled in together.
5. The cable jacket and/or conduit walls shall be completely lubricated when cable is pulled into conduit. The lubricant shall be applied immediately before or during a pull. Minimum quantities of lubricant are as follows:
 - a. One (1) quart of lubricant per 100 feet of 1-inch conduit
 - b. Two (2) quarts of lubricant per 100 feet of 2-inch conduit.
 - c. Three (3) quarts of lubricant per 100 feet of 3-inch conduit.
 - d. One (1) gallon of lubricant per 100 feet of 4-inch conduit.
 - e. This quantity shall be increased as needed for difficult pulling situations (high temperatures, multiple bends, poorly placed conduit, etc.)

3.3 Equipment Installation

- A. Boxes and cabinets shall be installed on the surface level and plumb and affixed to the surface with expansion inserts in concrete and machine screws to tapped holes in metal surfaces.

- B. Interconnections between equipment shall be made per manufacturer's wiring diagram. All wiring shall be clearly labeled and external connections in control panel and remote cabinet brought out to terminal blocks. All equipment connected to telephone lines shall be protected against voltage transients.

END OF SECTION

SECTION 16200

PACKAGED ENGINE GENERATOR SYSTEM

PART 1 – GENERAL

1.1 Description of Work

- A. This section covers the work necessary to furnish a diesel engine power generating system, complete and ready for operation, on a portable tandem axle trailer.
- B. The system described herein, including the engine-generator set, engine auxiliaries, fuel tank, weather housing, battery charger, control panel, and tandem axle trailer shall be furnished by a single manufacturer who is regularly engaged in the production of engine-generator sets and associated control products. The responsibility for performance of this specification in its entirety must be assumed solely by the MANUFACTURER of the system. Supply a complete portable generator system as specified herein, including a tandem axle trailer capable of safely towing the generator and accessories.

1.2 References

- A. The engine generator system shall be designed, manufactured and tested in accordance with the latest applicable NEMA, ANSI and NFPA Standards.

1.3 Listing and Labeling

- A. All material shall be listed and labeled for the purpose for which it is used by Underwriters Laboratories.

1.4 Submittals

- A. Submittals after award of contract shall be in accordance with Section 01300, and shall include, but not be limited to the following:
 - 1. Shop drawings indicating following information:
 - a. Outline drawings showing the proposed engine-generator set, drive system, fuel tank, and enclosure. Drawings shall indicate the required clearances for door and access panel opening, maintenance, refueling and cooling.

- b. Composite assembly drawing of engine-generator showing location of all auxiliary equipment, dimensions, and weight.
- c. Front, rear, and both side elevations of the complete engine-generator unit assembly.
- d. Specification sheets with performance data and engineering details adequate to determine compliance with Specifications of:
 - i. Engine (including engine cranking amperes at 20 degrees F)
 - ii. Fuel tank
 - iii. Generator and voltage regulator
 - iv. Housing
 - v. Control panel with all components
 - vi. Jacket water heater
 - vii. Engine-mounted fuel pump
 - viii. Governor
 - ix. Battery system
 - x. Exhaust silencer
 - xi. Battery charger
 - xii. Alarms
 - xiii. Fuel consumption rates
- e. Electrical interconnection diagram including generator, voltage regulator, control panel, batteries, jacket heater, switches, and accessories.
- f. Complete identification of all components and materials by manufacturer, model number, rating, and material.
- g. Complete engine and generator voltage dip and load data. Provide calculations to show compliance with specified performance requirements specifically prepared for this project.
- h. Wiring diagrams for generator excitation and regulation circuits, alarm circuits, and instrument circuits.
- i. Elementary control diagram and separate wiring diagram for automatic engine starting and protective shutdown controls. These diagrams shall show a wire number for every control circuit wire. Include a comprehensive description of operation.
- j. Detailed description of factory testing program, testing equipment, reporting procedure, and criteria for test passing or failing.
- k. Three copies of certified factory test report.
- l. Detailed description of field testing program, including description of tests, testing equipment, reporting procedure, and criteria for test passing or failing. (This may be a separate submittal made at a later time, but no later than 30 days before the actual tests.)
- m. Submit sound ratings at 23 feet when the unit is enclosed in the manufacturer's sound absorbing housing.

B. Operation and maintenance information.

1.5 Factory Tests

- A. The engine-generator system shall be tested, before shipment of the equipment.
 - 1. The tests shall be conducted under rated load and power factor for performance and functioning of control and interfacing circuits. Tests shall include:
 - a. Single-step load pickup.
 - b. Transient response and steady-state governing.
 - c. Alternator temperature rise by resistance method.
 - d. Fuel consumption.
- B. The OWNER will not witness the factory tests.
- C. The MANUFACTURER shall provide documentation of the test results to the OWNER.

1.6 Warranty

- A. Shall be provided for all products against defects in materials and workmanship for a one year period from the start-up date.

PART 2 – PRODUCTS

2.1 Acceptable Manufacturers

- A. Onan/Cummins, Caterpillar, Kohler or approved equivalent and shall be a model with consumable items readily available in the Puget Sound area.

2.2 General

- A. The engine-generator set shall be UL listed and rated for standby power operation for duration of any power outage.
- B. The engine-generator set shall be adequately sized to provide power to the pump station including all three pumps operating simultaneously as well as miscellaneous building power requirements including, but not limited to lighting and control panels.
- C. The packaged engine generator system equipment shall be the standard of a single MANUFACTURER. It shall be factory built, tested, and shipped in the United States of America. The MANUFACTURER shall have been regularly engaged in the production of packaged engine generator system equipment for a minimum of five (5) years.

2.3 Engine

- A. The general design of the engine furnished shall be the standards of the manufacturer, except where these differ from the requirements of these Specifications. The design shall be such as to provide adequate strength of all parts for the specified duty. The complete engine-generator unit shall be mounted on a common steel fuel tank sub-base.
- B. The engine shall be a four-cycle diesel type suitable for a continuous output as specified herein when driving a synchronous generator at a speed not exceeding 1,800 rpm. Horsepower ratings shall be adequate for 1,000 foot elevation operation. Minimum engine displacement shall be 504 cubic inches with 6 cylinders.
- C. The engine shall be equipped with automatic starting by a 12-volt or a 24-volt battery driven starter acting in response to the automatic transfer switch, hereinafter specified. Batteries shall be 200 amp-hour minimum capacity and the 24-volt system may be either one 24-volt or two 12-volt batteries in series. The batteries shall be housed in an acid-resistant frame, or box, which shall be mounted adjacent to the engine within the enclosure. The battery shall be protected against the cold down to -10 degrees Fahrenheit. Location of the battery container shall not interfere with maintenance and inspection of the engine.
- D. A fuel oil transfer pump driven off the engine shall be provided to pump the fuel from the integral tank to the engine. This pump shall be suitable for operation with a 12-foot suction lift. A fuel oil filter with replaceable element shall be provided. Fuel connections to engine shall be with flexible hose suitable for the purpose at least 18 inches long.
- E. The governor shall be electronic and shall provide speed drop externally adjustable from isochronous to 5 percent. The governor shall be set to isochronous. An overspeed trip shall be provided.
- F. The jacket water cooling system shall consist of an engine mounted radiator with jacket water pump, fan, assembly, and fan guard.
- G. Provide an engine thermostat to regulate engine coolant temperature as recommended by the manufacturer. Provide a high-coolant temperature device to shut down the engine through the engine control panel when the engine temperature exceeds 200 degrees F. Jacket water heaters suitable for operation on 120-volt, 60-Hz current shall be provided to maintain engine water temperature at 120 degrees F with an ambient temperature of 50 degrees F. Heaters shall be thermostatically controlled. The engine cooling system shall be

filled with a mixture of water and permanent type antifreeze to protect the system to a temperature of -10 degrees F.

- H. The engine lubricating system shall be the full-pressure type with a device to shut down the engine through the engine control panel on low oil pressure. Provide an oil filter with replaceable element and a bayonet type oil level stick. Provide a valved oil drain extension.
- I. Lubrication oil shall be cooled by a water-cooled heat exchanger utilizing jacket water.
- J. The engine air intake shall be equipped with a dry type air cleaner with filter service indicator.
- K. Instrumentation to be provided shall include an oil pressure gauge, coolant temperature gauge, tachometer, fuel pressure gauge, and running time meter. These gauges shall be installed on the engine starting panel as described under GENERATOR CONTROL PANEL.
- L. Safety shutdowns: Provide sensing elements to shut down the engine immediately when conditions reach a level deemed harmful to the unit. Provide individual signal light and alarm contacts for each condition. Safety shut downs shall include:
 - 1. Low lubricating oil pressure
 - 2. High coolant temperature
 - 3. Overspeed
 - 4. Overcrank
 - 5. Low coolant level
 - 6. Low cooling water flow
 - 7. Any additional conditions standard with the manufacturer.

2.4 Generator

- A. The generators shall be single-bearing, synchronous type, suitable for direct connection to the engine. The generator shall be rated as shown on the drawings, at 60 Hz, standby.
- B. A permanent magnet generator (PMG) shall provide excitation power to the automatic voltage regulator for immunity from voltage distortion caused by non-linear SCR controlled loads from the generator. The PMG shall sustain main field excitation power for optimum motor starting and to sustain short circuit current for selective operation and coordination of system overcurrent devices.

- C. The engine generator unit shall have a steady state voltage regulation not exceeding plus or minus 1 percent. Frequency regulation shall be isochronous. Transient voltage dip shall not exceed 20 percent of rated voltage with a sudden application of rated load, and recovery to rated steady state conditions shall occur within 2 seconds following the load change.
- D. The generator shall be supplied with a voltage level control to provide an adjustable output voltage of plus or minus 5 percent. The voltage control device shall be mounted on the engine starting panel.

2.5 Generator Control Panel

- A. Provide an NFPA-110 Level 1 control panel. When the engine fires, starting control shall automatically disconnect the cranking control and prevent re-cranking for a definite period of time after engine stops. The starting control panel shall be vibration isolated with hooded panel lights, in a sound attenuated weatherproof enclosure.
- B. Four cranking cycles of 10 seconds ON and 10 seconds OFF shall be provided prior to lockout on overcranking.
- C. Fault indicating lamps on the panel shall be push to test type and shall indicate low oil pressure, high water temperature, overspeed, and overcrank. The engine shall shut down under any of these conditions and may not be restarted until the system is manually reset. Provide low fuel level and fuel leak indicating lamps.
- D. A three position selector switch shall be provided in the panel for AUTO, OFF, MANUAL.
- E. A fully automatic float/equalize, constant voltage, current limiting, type battery charger, suitable for operation on 120-volt power shall be furnished within the enclosure. The charger shall be equipped with a DC voltmeter, a DC ammeter, loss of power light, low battery voltage light, high battery voltage light and power on light which shall be mounted on the face of the cranking panel and match the generator instrumentation.
- F. The starting control panel shall include a panel type 3-1/2-inch ammeter with phase selector switch, a panel type 3-1/2-inch voltmeter with selector switch and frequency meter (vibrating reed type) mounted on the engine starting panel. All necessary instrument transformers shall be included.
- G. The starting control panel shall have sufficient space to permit mounting of the engine and generator instrumentation specified under DIESEL ENGINE and under GENERATOR on the face. All instruments shall be identified either on

the instrument face or by engraved, black, laminated plastic nameplates with white 1/4 -inch high letters. Control panel shall be mounted so that panel is less than 6' AFG.

- H. Provide a mounted molded case circuit breaker sized correctly for the generator output.
- I. Form C dry contacts shall be prewired to terminal blocks in the control panel for remote indication of the following status and alarm conditions.
 - 1. Generator Running
 - 2. Generator Fail
 - 3. Low Fuel Alarm
 - 4. Fuel Leak Alarm

2.6 Main Circuit Breaker

- A. The main circuit breaker shall be molded case breaker with inverse time and instantaneous tripping characteristics. The current rating shall be 125% of the generators rated full load output current.
- B. Circuit breaker shall be housed within the generator enclosure or on a generator mounted NEMA 3R enclosure. Enclosure size shall be large enough to allow termination of load cables as well as feeder cables for load bank receptacles.

2.7 Battery Charger

- A. Provide a constant potential, current-limiting type, designed to float at 2.17 volts per cell and equalize at 2.33 volts per cell. Provide low battery voltage alarm contacts for remote annunciation. Include a DC ammeter. The input power to the charger shall be at 120VAC. Manufacturer: Charles Industries or equal.

2.8 Coolant Heater

- A. Provide a thermostatically controlled coolant heater sized appropriately by the generator manufacturer. Heater shall be rated 120V, 1-phase, 60Hz.

2.9 Fuel Tank

- A. Provide a sub-base mounted tank with a minimum capacity of 12 hours of engine-generator set operation at 100 percent of full rated load. Tank shall be standard design as provided by the MANUFACTURER. The tank shall be

double walled. Provide level gauge, makeup control valve, drain valve, and overflow valve. Provide pipe and fittings from tank to engine fuel system.

- B. Provide low fuel level indicator for remote alarm annunciation.
- C. Provide leak detection system for remote alarm annunciation.

2.10 Mounted Exhaust System

- A. An exhaust silencer shall be provided. The silencer shall be of chambered construction and shall be of the critical silencing type and shall provide a maximum dBA level of 75 at a distance of 23 feet in a free field environment. Silencer shall be sized to assure proper operation without excessive back pressure when installed in the exhaust system.
- B. Provide support system (seismic zone 4) for exhaust system and piping in accordance with applicable codes. The exhaust silencer shall be supplied with a condensation trap and rain cap.
- C. Provide flexible connections of the exhaust system at the engine. Flexible bellow exhaust pipe shall be seamless stainless steel exhaust pipe with a minimum length of 12 inches.

2.11 Spare Parts

- A. The following spare parts shall be furnished:
 - 1. 3 sets of fuel oil filter elements and gaskets.
 - 2. 3 lubricating oil filter elements and gaskets.
 - 3. 1 air cleaner filter element.
 - 4. 2 sets of V-belts for fan and pump drives.

2.12 Sound Attenuated Weather Protective Housing

- A. The engine generator sets shall be enclosed in weather protective sound attenuating metal housing. The enclosure shall be of a pre-painted sheet metal construction with sound insulation that reduces the engine generator noise to maximum of 75 dBA at 23 feet from the generator in all directions. The weather protective housing shall be designed to permit sufficient flow of air for efficient cooling and combustion in an ambient temperature of 50 degrees C (122 F).
- B. The enclosure shall include hinged doors for access to both sides of the engine and alternator, and the control equipment. Pad-lockable door latches shall be provided for all doors. Door hinges shall be stainless steel.

- C. A single junction box shall be provided in the enclosure for power to jacket water heaters and battery charger.
- D. Housing shall be manufactured by the generator MANUFACTURER.

2.13 Factory Paint

- A. The complete engine-generator set, including the instrument panel, shall be given a factory-applied primer and two finish coats of the MANUFACTURER's standard heat-resistant engine paint. All areas damaged during shipment shall be touched up after installation.
- B. Painting of hoses, clamps, wiring harnesses, and other non-metallic service parts shall not be acceptable. Fasteners used shall be corrosion resistant, and designed to minimize marring of the painted surface when removed for normal installation or service work.

2.14 Trailer

- A. The packaged generator assembly shall be mounted on a heavy duty tandem axle trailer for transport. The trailer assembly shall be manufactured to meet applicable Federal Highway and Washington Department of Transportation requirements for gross vehicle weight, dimensions, lighting, and signals.
- B. Fabrication of the trailer shall comply with Section 05500, Metal Fabrications. Coating shall comply with Section 09800, Protective Coatings.
- C. The engine generator unit shall be provided with integral vibration isolators, with the engine and alternator isolated from the main trailer support frame.
- D. The trailer shall be of the reinforced channel or rectangle tube box frame type. The chassis frame shall be manufactured of channel on all sides and shall have reinforcement. The tongue shall be an extension of the side members, V-notched, bent, and the V's welded closed after forming.
- E. The trailer shall be provided with heavy duty drop axles such as to reduce the overall height of the generator assembly and shall have adequate overhang capacity. The axles shall be suspended from the trailer frame by leaf-type springs.
- F. Fenders shall be provided with fender tops covered with anti-skid materials.
- G. A spare wheel with mounted tire, matching the road wheels in all aspects, shall be mounted to the trailer with a single lockable lug.

- H. Mounting Hitch. The mounting hitch provided with the unit shall be a 2-5/16 inch ball to match the Owner's vehicle. The mounting hitch shall be provided with a pintle eye which can be adjusted in height to match the hitch heights of various tow vehicles.
- I. Adjustable Jack Stand. The adjustable jack stand with sand shoe provided on trailer tongue shall have a hand-operated crank to raise or lower the front end into position for hookup to the towing vehicle. The jack stand shall be capable of supporting a load of 5,000 pounds, minimum.
- J. Manufacturers/Fabricators: S.F. Steel of Estacada, Oregon, or approved equivalent.

PART 3 – EXECUTION

3.1 Installation

- A. Install engine-generator system in accordance with the MANUFACTURER's instructions. Installation shall comply with applicable state and local codes as required by the authority having jurisdiction.
- B. Provide all initial fills of fuel oil, lubricating oil and coolant per manufacturer's instructions. Refill fuel oil after testing is complete and accepted.

3.2 Onsite Acceptance Testing

- A. The complete installation shall be tested for compliance with the specification following completion of all site work. Testing shall be conducted by representatives of the MANUFACTURER, with required fuel supplied by CONTRACTOR. The ENGINEER shall be notified two weeks in advance and shall witness the tests.
- B. Conduct a "Cold Start" test per NFPA 110 (1988), 5-13.2.3. with the unit connected to the required load bank.
- C. Provide a four hour full load test per NFPA 110, 5-13.2.5. The CONTRACTOR shall provide a portable resistive load bank and make temporary connections. Data which is specified to be recorded in the "cold start" test shall be recorded at the start of the full load test and every 15 minutes thereafter. The unit shall be connected to the required load bank during this test.

- D. Provide a one step rated load increase and decrease test in accordance with NFPA 110, 5-13.2.6. The unit shall be connected to the required load bank during this test. Use a recording oscilloscope to measure voltage and frequency transients. This test can be performed by an independent testing agency or a consultant on completion of the MANUFACTURER's on-site acceptance test.
- E. Provide a four hour functional test of all pump station operations under loss of normal power. The unit shall be connected to the manual transfer switch during this test. This test shall include manual start-up, transfer of the load, and manual shutdown. Engine coolant temperature, oil pressure, and battery charge level along with generator voltage, amperes, and frequency shall be monitored throughout the test.
- F. Alarm, Control and Equipment Tests:
 - 1. Demonstrate that each alarm and safety shut down equipment is working properly.
 - 2. Demonstrate the proper operation of each control circuit and device.
- G. Ensure that the phase rotation of the engine-generator set and utility are compatible at the site.

3.3 Manufacturer's Startup Services

- A. Provide the services of a qualified factory-trained MANUFACTURER's representative for a period of one working day minimum. The representative shall certify that the equipment has been installed, adjusted and tested in accordance with the MANUFACTURER's recommendations.

3.4 Training

- A. Provide on-site training to the Owner for 8 hours. The training shall be arranged for at least four persons.
- B. The training shall be conducted by the engine-generator MANUFACTURER, or their factory-trained representative.
- C. The training program shall include instruction on the assembly, operation and maintenance of all major components.

3.5 Preparation of Operating and Maintenance Manuals

- A. Provide manufacturer's catalog information and diagrams (specific only to the equipment supplied), installation manual and Operating and Maintenance Manuals.

END OF SECTION

SECTION 17010

INSTRUMENTATION AND CONTROL SYSTEMS

PART 1 GENERAL

1.1 Description of Work

- A. **GENERAL:** This section specifies general requirements applicable to process instrumentation systems consisting of process sensors, monitoring and control devices, and accessories required to provide a complete and fully functional monitoring and control system (System).
- B. **RESPONSIBILITY:** The SUPPLIER shall provide, configure, calibrate, program, test, and commission all components of the instrumentation, control, communications, and network systems supplied unless noted otherwise (UNO). The SUPPLIER shall place the completed systems in operation, including tuning loops and making final adjustments to instruments as required during plant start-up. The SUPPLIER shall provide the services of instrument technicians for testing and adjustment activities.
- C. **RELATED REQUIREMENTS:** Division 17 is an extension of, and includes all of the requirements of Division 16, Electrical. All work performed under Division 17 shall also comply with the applicable sections of Division 16 as well as the general provisions of Divisions 0 & 1.

1.2 Contract Requirements:

- A. General Conditions, Supplementary Conditions, and Division 1 apply to Work in this section.
- B. Listing:
 - 1. All materials and equipment specified herein shall be within the scope of Nationally Recognized Testing Laboratory (NRTL) examination services, be approved by the NRTL for the purpose for which they are used, and shall bear the appropriate listing/label.
 - 2. Equipment shall be listed/labeled by an NRTL acceptable to the local authority having jurisdiction.
 - 3. When a product is not available with a listing/label for the purpose for which it is to serve, the product may be required by the inspection authority to undergo a special inspection at the MANUFACTURER's place of assembly or as a completed assembly in the field. All costs and

expenses incurred for such inspections shall be included in the original contract price.

1.3 Reference Standards

- A. NFPA – National Fire Protection Association
 - 1. NFPA No. 70, NEC - National Electrical Code.
 - 2. NFPA No. 79, Electrical Standard for Industrial Machinery.
- B. ISA – Instrumentation, Systems, and Automation Society.
- C. ICS – NEMA (National Electrical Manufacturer's Association) Industrial Control and Systems including:
 - 1. ICS-1 – General Standards for Industrial Control and System.
 - 2. ICS-2 – Standards for Industrial Control Devices, Controllers and Assemblies.
 - 3. ICS-3 – Industrial Systems.
 - 4. ICS-4 – Terminal Blocks for Industrial Control Equipment and Systems.
 - 5. ICS-6 – Enclosures for Industrial Controls and Systems.
- D. ANSI/IEEE – American National Standards Institute/Institute for Electrical and Electronics ENGINEERS.
- E. State and Local codes and ordinances.
- F. NETA – National Electrical Testing Association.

1.4 Operation and Maintenance Manuals

- A. The SUPPLIER shall provide (6) hard copy and (2) electronic detailed sets of Operation and Maintenance (O&M) manuals with complete information concerning the operation of the System within 30 days after start-up of the equipment. The O&M manuals shall include information related to diagnosis, down to the module and card replacement level.
- B. The manuals shall include all project specific information. Electronic copies shall be furnished in PDF, ACAD DWG, or Microsoft Word compatible formats, as required. The O&M Manuals shall contain descriptive material, drawings, and figures.
- C. The manuals shall include operation and maintenance literature for the entire System and all components provided. The submitted literature shall be in sufficient detail to facilitate the operation, removal, installation, adjustment, calibration, and maintenance of each component provided.

- D. The manuals shall include data sheets for all significant equipment used in the System. Significant equipment is defined as equipment performing a function other than simple interconnection. The data shall include, as a minimum, the component name, manufacturer, model number, quantity, and any special O&M characteristics.
- E. Factory calibration data sheets shall be included for all transmitters and transducers.
- F. The manuals shall include wiring diagrams for all components provided. These wiring diagrams shall clearly show all terminals, terminal block number designations, and wire numbers. Diagrams, device designations, and symbols shall be in accordance with NEMA ICS 1-101.
- G. Layout drawings for each panel shall include overall dimension details for each component and all door mounted operator devices including nameplate designations.
- H. Drawings shall include interconnecting wiring diagrams of all equipment installed or connected under this contract.
- I. The manuals shall include a detailed functional description of the System. Control loops shall be fully described in the functional description. A detailed description of remote site features such as I/O and local control loops shall be included.
- J. All components shall be identified with their complete tag number as designated by the SUPPLIER.
- K. All components without tag numbers shall be grouped within component type by manufacturer's part number. Exact quantities shall be listed for each part number.

PART 2 PRODUCTS

2.1 General

- A. Major Equipment at this Site shall include, but is not limited to:
 - 1. Programmable Logic Controller (PLC);
 - 2. NEMA 12 enclosure;
 - 3. Pressure transmitters (2);
 - 4. Complete configuration & programming;
 - 5. Operator Interface Unit
 - 6. Other devices as needed to provide a complete and operable installation.

2.2 Programmable Logic Controller (PLC) Based Equipment Control

Provide one (1) complete Programmable Logic Controller (PLC) based control system as described herein. The system shall employ industry standard programmable logic controllers as described herein. The system shall be completely factory integrated and tested in the factory and field run-in with factory personnel.

A. PLC Equipment

The design is based on the Allen-Bradley 1400 Series Programmable Logic Controller. Communications, interface, input/output and other peripheral devices have been proven to be 100% compatible with the Allen-Bradley equipment. No other PLC equipment is acceptable unless the ENGINEER provides notification of alternate system approval by addendum prior to the bid date.

B. Complete System Responsibility

The station MANUFACTURER shall be the System Integrator and as such will assume full and complete responsibility for the station PLC Control System and related control functions.

This assumption of full responsibility shall include identifying all electrical, mechanical and plumbing schematics and wiring interconnect diagrams, providing instrument installation details, preparing input/output listings, writing software, performing software and hardware integration, installation in the station at the factory, debugging, calibrating and tuning the various components and subsystems and providing training and warranty services.

C. U.L. Listing Requirement

The system integrator shall produce panels that fully comply with Underwriters Laboratory Standard for Industrial Control Panels #508A.

All panels shall be UL 508A listed. The UL 508A "sticker" shall be clearly displayed in the appropriate location within the panel. The UL 508A listing shall be in the name of the equipment manufacturer.

D. System Integrator Facility and Staff

The station MANUFACTURER shall have on staff no fewer than four (4) full time Control System Engineers who are dedicated to the development of PLC programs, SCADA software, instrumentation configuration and control logic development. The system integrator shall have no fewer than three (3)

electrical engineers on staff dedicated to the development of panel wiring diagrams, panel layouts and general electrical design.

The system integrator shall have a field service department with no less than 5 fully equipped, trained and competent field service technicians able to work on any and all devices provided with this system. The system integrator shall have been in the business of providing telemetry, control and SCADA systems to the water production and water distribution market for no less than 7 years.

The system integrator shall submit a list of all personnel with title, job function, years with the company, years in this field and educational achievements with the submittal. Companies that do not meet the above requirements will not be approved.

E. Control Panel Design, Assembly, and Test

The PLC panel design and assembly, the integration of component parts and startup will be the responsibility of the manufacturer of record for the factory-built water distribution equipment. That manufacturer shall maintain at its regular place of business a complete PLC design, assembly and test facility to assure continuity of control design with equipment application.

F. General Equipment Specification for PLC Control Systems

1. Enclosures:

Enclosures shall be NEMA 4 for indoor and outdoor locations. Enclosure shall be fabricated from a minimum of 14-gauge cold rolled steel with a baked enamel finish in the manufacturer's standard color. Units shall include a single gasket front door with continuous hinge. Hinges, locking hasp and door clamping hardware shall be included.

2. Incoming Power Requirements & UPS:

Controls shall operate from a source of 120 volts, 1 phase, 60 Hz. Each panel shall be accompanied with an uninterruptible power supply (UPS). The UPS shall condition the power as well as provide 1000 VA of power during outages. A 10-amp control power circuit breaker shall be employed as both a method of equipment protection and as a means of power disconnection. The circuit breaker shall be a single pole, thermal, magnetic type with a 10,000 Amp Interrupt Current rating. The circuit breaker shall be UL listed.

3. Power Supplies:

All DC power supplies required for operation shall be provided. Units shall provide sufficient voltage regulation and ripple control to assure powered components can operate within their required tolerances.

4. Transient Voltage Surge Suppression (TVSS) – Data Communications and Signal Wiring:

The system manufacturer shall provide transient voltage and surge suppression for all PLC data communication devices whenever the communications cable is located outside the building in which the panel resides. This also applies to all outdoor panels with communications cables exiting the PLC panel enclosure. The TVSS unit shall be UL 497B listed. The TVSS unit shall have a maximum DC operating voltage of 9.6 VDC, a clamping voltage of 81V, and an 8 x 20 US surge current rating of 1000 amps. The unit shall be approved for use by Allen-Bradley Company on the Allen-Bradley Data Highway communications products.

Transient voltage and surge suppression shall also be provided for 10-32 VDC instrumentation signal systems. The TVSS units shall be employed when the signal cable extends beyond the boundaries of the building in which the PLC panel is located. The TVSS unit shall be UL 497B listed. The TVSS unit shall have a maximum operating voltage of 32 VDC, a clamping voltage of 100V, and an 8 x 20 US surge current capability of 1000 amps.

TVSS units must be as manufactured by Leviton, Inc., of Little Neck, New York, Model 3803-485/DHP for PLC communications and Model 3420-009/035 for 10-32 VDC signal wiring, without exception.

5. Wiring Requirements:

All wiring shall be in complete conformance with the National Electrical Code, state, local and NEMA electrical standards. All incoming and outgoing wires shall be connected to numbered terminal blocks and all wiring neatly tied and fastened to chassis as required.

6. Network Data Line Surge Suppressors:

Provide transient surge suppressors for all leased telephone line, and Ethernet connections that are included as a part of this system. Unit shall have connection capabilities for RJ45, 100 BASE-T, 10 BASE-T, Token Ring, and RS-422 connections. The unit shall have a nominal

clamping voltage of 7.5 volts and a Peak Pulse Current rating of 750 amperes. Unit shall be as manufactured by Tripp Lite, Inc., Model DNET-1.

7. Telephone Line Surge Suppressors:

Provide the following for all dial-up connected to data modems or automated alarm dialing equipment that are included as a part of this system. Unit shall have connection capabilities for RJ11 or RJ45. The unit shall have a nominal clamping voltage of 260 volts and a Peak Pulse Current rating of 1020 amperes. Unit(s) shall be as manufactured by Tripp Lite, Inc., Model DTEL2.

G. Programmable Logic Controller (PLC), Micrologix 1400

The PLC shall be manufactured by Allen-Bradley Co., a division of Rockwell International being Model Micrologix 1400, series 1766.

Provide microprocessor-based Programmable Logic Controllers (PLC) as detailed in this specification and on the applicable plan sheets. The PLC shall be capable of use in a stand-alone configuration and also be capable of being networked into a larger system. It shall be specifically suitable for use in a telemetry system as an intelligent remote telemetry unit. The PLC shall be programmable in standard ladder logic.

The PLC shall have a processor and thirty-two (32) embedded discrete I/O. The I/O shall be expandable with the use of expansion I/O. The expansion I/O shall not require a "rack" in which to be mounted.

The program shall be stored on non-volatile Electrically Erasable Programmable Read Only Memory (EEPROM) modules. The CPU shall have 10,000 bytes (10K) user memory and perform 32 bit signed math functions. The CPU shall have integral to it, two communications ports capable of RS-232 DF-1 half, and full duplex serial communications as well as MODBUS RTU Slave protocol, and DF-1 radio modem. The CPU also shall have a third port integral to it a communications port capable of Ethernet communications. The CPU shall have on-line programming feature without interrupting the program running at the time.

The PLC shall be powered from 85/265 VAC 60 Hz line power.

The PLC shall be U.L. listed, C-U.L. listed, CE compliant and suitable for use in Class 1, Division 2, Groups A, B, C and D environments.

1. The PLC shall be equipped with the following embedded discrete I/O:

- i. 20 - 120 VAC inputs.
- ii. 12 - relay outputs.

The CPU shall have a LCD display integral to the unit for display of status and selectable information.

2. The PLC shall have expansion I/O capabilities as follows:

i. Discrete Input Modules:

Discrete input modules shall be available in 8 channel configurations. The modules shall accept 20-48 VDC, 100-240 VAC signals. Modules shall have a removable terminal strip.

ii. Relay Output Modules:

Relay output modules shall be available in 8 channel versions. Modules shall be rated for 5-265 VAC and 5-125 VDC voltages.

iii. Analog Input / Output Module:

Analog input modules shall be available in 4 channel configurations, 2 inputs and 2 outputs. The modules shall be rated for input signals between 4 mA and 20 mA., or 0 – 10 VDC. The module shall employ a 12 bit analog to digital conversion chip. Outputs shall be either 0-10 VDC or 4-20 mA DC. The output digital to analog converter shall have 12 bit resolution.

H. Operator Interface Equipment, 10” Color

The PLC control system shall include a front panel mounted touch screen display for operator interface. The display shall have a 8.3" x 6.2" screen with 640 x 480 pixel resolution using 18-bit color graphics. The touch screen shall use Analog Resistance. Unit shall have a battery backed real time clock. The unit shall have RS-232 and Ethernet communications ports. The unit shall have 64 megabytes of memory.

All required communication modules, cables and accessories shall be provided for a complete and operational system.

The Color Touch Screen Operator Interface shall be manufactured by Allen-Bradley Co., a division of Rockwell International, Milwaukee, WI,

Panelviewtm Plus Compact 1000C Color Touch Screen Operator Interface
Model #2711PC-T1064D1.

I. Programming Software

All PLC equipment supplied on this project shall be programmable in standard ladder logic. The ladder logic development and configuration software shall be the same for all PLC's listed in this specification. Equipment requiring separate program development and configuration software for each product is not acceptable.

The software program shall be Windows based and be Microsoft certified for use with Windows NT, Windows 95, Windows 98 and future versions.

The software shall be able to develop the ladder logic programs, provide equipment configurations, diagnostics for both equipment and software, upload programs, download programs, and edit programs "on-line" where applicable.

The software shall be as manufactured by Rockwell Software, a division of Rockwell Automation, Model RS-LOGIX 500.

J. Operation Description for PLC Based and VFD Controlled Pumping System

There shall be control algorithms programmed into the Programmable Logic Controller to operate the system based on an operator adjustable discharge pressure output setpoint.

The system shall control pump starting and stopping, the cascading of pumps and pump speed through the variable frequency drives based upon station flow with safety cutouts based upon suction pressure and discharge pressure and pump speed. The PLC shall be programmed by personnel who are an employee of the station MANUFACTURER to insure a single source of responsibility and maintenance.

The station PLC shall receive a "station start" call from the telemetry. Once the start call input is made, the PLC/VFD system shall operate automatically to adjust the output of the selected pump in order to maintain an adjustable discharge pressure setpoint for the operation of the station.

Pump output shall be adjusted by varying the speed at which it operates. The speed shall be controlled by a variable frequency drive (VFD) and the calculation of needed pump speed shall be performed by a programmable logic controller (PLC) which shall have input to it a signal directly proportional to the discharge pressure of the station.

The PLC shall employ a standard Proportional Integral and Derivative algorithm to calculate the 4-20mA speed reference output to the drives needed to maintain the station setpoint. Initially, the VFD's shall provide ramping speed control on start and stop. When the station PLC receives a "station stop" call from the telemetry, the pump station PLC shall start ramping down the VFD's.

In the event of a communication failure, the station shall run at the last known setpoint until the failure has been corrected.

The pumps shall be brought on and off line in a cascading sequence as controlled by the pump selection/alternation portion of the control algorithm. Pump speed, with two or more pumps online, shall be the same for all pumps. When a pump comes online, its speed shall increase from the minimum speed while the online pump(s) speed shall be decreased, all to a speed which meets demand.

Pumps going offline shall be done in the opposite manner to avoid pressure surges in the system.

Pump speeds shall be set at the minimum allowed for the proper motor cooling. These minimum speeds shall be set into the VFD program parameters.

Manual speed control can be accomplished through the use of a speed adjustment feature on the VFD unit.

Each unit shall have a Hand-Off-Automatic switch, speed adjustment and status.

2.3 Gauge Pressure Transmitters

Pressure transmitters shall be supplied to measure suction and discharge pressure. The transmitters shall sense gauge pressure and transmit a 4-20 mA dc signal. The instruments shall measure pressure of a predetermined span. Range is to be fully adjustable throughout using allowable span and range limits. The accuracy shall be $\pm 0.20\%$ of span.

Each transmitter shall provide an analog output and include a standard LCD with pushbuttons to provide Intelligent transmitter configuration directly from the on-board pushbuttons. The two-line digital indicator shall display the measurement in any selected units. The pushbuttons shall provide calibration of zero and span, setting of linear output, forward or reverse direction, external zero enable or disable, damping, failsafe action and local display including upper and lower range value selection.

All process-wetted parts of each instrument shall be Type 316L stainless steel. The transmitter shall be protected by a gasketed, weatherproof NEMA 4X enclosure. The transmitter shall be approved for use in hazardous locations (Non-incendive for Class 1 and Class II, Division 2 locations; intrinsically safe or explosion-proof for Class 1 and Class II, Division 1 locations).

The transmitter shall have 1/2 inch NPT female threaded tapping ports.

Gauge Pressure Transmitter shall be Foxboro Series IGP10 or approved equal.

2.4 Discrete Local Pressure Control

Separate from the control logic and where remote control/input via telemetry is interrupted or local control is switch selected control of the pumps shall be provided by bellows type, adjustable differential pressure switches. Each switch assembly will be complete with a single pole, double throw contact block with 5 amp non-inductive rated contacts at 230 volts AC. The set points of the on/off cycle shall be independently adjustable through the full range of the switch rating.

1. Start Lead Pump, 4-150 psi control range.
 - 1A. Adjustable Differential, 2-25 psi.
2. Start Back-up Pump, 4-150 psi control range.
 - 2A. Adjustable Differential, 2-25 psi.

A pressure gauge shall be sub-panel mounted adjacent to the discharge pressure switches. The gauge and switches shall be so plumbed with the discharge header sensing line that a common blow off valve can relieve pressure in all simultaneously for purposes of checking and calibrating the start-stop functions of the pumps.

PART 3 EXECUTION

- 3.1 Expertise of Installer: Installation shall be performed by the workers who are skilled and experienced in the installation of electrical instrumentation and control systems. Installation shall include all elements and components of the control systems and all conduit and interconnecting wiring between all elements, components, sensors, valve operators, etc.
- 3.2 Location: Equipment shall be located so that it is readily accessible for operation and maintenance.
- 3.3 Tagging: All field devices shall be labeled with tag number indicated in the bid documents or consistent with project tagging conventions when not shown in the bid documents. Comply with project naming and numbering conventions. Tag shall be

10ga, 316 stainless steel with stamped letters and numbers attached to device with 12ga, 316 stainless steel wire.

3.4 Electrical Power and Signal Wiring

- A. Control and signal wiring external to the panels and all power wiring shall conform to the requirements of Division 16 - ELECTRICAL.
- B. Control and signal wiring in panels shall be restrained by plastic ties or ducts.
 - 1. Hinge wiring shall be double secured at each end with mechanically fastened, not adhesive, tie blocks or straps.
 - 2. Hinge crossings shall be either longitudinal crossings with a minimum length of 12 inches, so that any bending or twisting will be around the longitudinal axis of the wire, or loop crossings with a minimum loop diameter of 6 inches.
 - 3. The entire length of wire in the bend area, (between the tie blocks) shall be protected from abrasion with either convoluted tubing or spiral wrap.
 - 4. Wire bundles that pass through holes shall be protected from abrasion with either grommets or sleeves.
 - 5. Wires that pass across edges of sheet metal shall be protected from abrasion.
- C. Arrange wiring neatly, cut to proper length, and remove surplus wire.
- D. Use manufacturer's recommended tool with the proper sized anvil for all crimp terminations. No more than two wires may be terminated in a single crimp lug and no more than two lugs may be installed on a single screw terminal.
 - 1. All crimp lugs used in applications with two wires terminated in a single crimp lug shall be rated by the manufacturer for multiple wire use.
- E. Wiring shall not be spliced or tapped except at device terminals or terminal blocks.

3.5 Disconnect Switches: Power disconnect switches shall be provided within sight of equipment and shall be labeled to indicate opened and closed positions and specific equipment served. "Within sight of" is defined as having a clear unobstructed view from the equipment served and within 50 feet of the equipment served. Disconnect switches shall be mounted between 36 inches and 72 inches above the floor or permanent work platform. Where equipment location is such that the above requirements cannot be met by a single disconnect switch, two switches, one at the equipment and one at the work platform, shall be provided.

3.6 Surge Arrestors: Each disconnect switch serving equipment located outdoors shall be provided with a surge arrestor, General Electric 9L15CCB001, or equal. The surge

arrestor shall be bonded to the plant ground grid with a No. 8 AWG bare copper conductor.

- 3.7 Control Panels: All control panels shall be provided with a main power disconnect equipped with auxiliary contacts as required to disconnect all power sources to the panel or shall be labeled to indicate the multiple power sources not disconnected by the main disconnect. Field wiring for all power sources not disconnected by the main disconnect shall land on fused disconnect type terminal blocks.

3.8 Operation and Maintenance Data

O&M MANUALS: The Control Systems Integrator (CSI) shall prepare and assemble six (6) sets of operation and maintenance (O&M) manuals in accordance with the project general requirements and Paragraph 1.04 of this section. These manuals shall be submitted two weeks prior to training. O&M manuals shall include, but not be limited to, the following:

- A. Trouble-shooting procedures
- B. Calibration procedures
- C. Testing procedures
- D. Component replacement procedures
- E. Preventative maintenance procedures
- F. Listing of recommended spare parts
- G. Listing of recommended maintenance tools and equipment
- H. Catalog data for all equipment and devices supplied, organized per submittal requirements
- I. Configuration, setup, and programming manuals for all programmable devices supplied including PLC, VFD, instruments, etc.
- J. Communication channel test forms
- K. Calibration and test forms for all field switches, instruments, PLC IO, VFD IO, etc.
- L. Configuration files for all configurable or programmable electronic devices and equipment supplied for this project

- M. Application software program documentation for all programs and configurations developed or supplied by the SUPPLIER for this project
- N. System user's manual covering all functions supplied by the SUPPLIER for this project as described below

3.9 Record Documents: All contract P&ID drawings and control strategy specification sections and all submittal drawings shall be revised to reflect as-built conditions at the end of the project. Record drawings and documents shall be submitted in accordance with the project general requirements and Paragraph 1.04 of this section. Record drawings and documents shall be submitted with the O&M manuals. Record drawings and documents shall include the following:

- A. Shop drawings
- B. Wiring diagrams of cabinet and enclosure contained assemblies
- C. Wiring diagrams of all system connections and interconnections including all loops, field equipment, communications interfaces, networks, etc.
- D. All other submitted shop and installation drawings and details not listed
- E. Bill of Material
- F. Contract P&ID drawings
- G. Contract control strategy specification sections

3.10 System Users Manuals

The CSI shall develop and submit a detailed user manual covering all aspects of the operation and use of the components and systems they supply. The manual shall cover the following:

- A. An overview of the architecture of the control system including control panels, MCC's, field devices, PLC, OIT, SCADA, data historian, remote alarm notification, communications, networks, remote access, etc.
- B. All hardware/hardwired, programmed, manual, automatic, display, control, alarming, communications, networking, etc. features and functions of the systems and components they supply.
- C. Descriptions of the meaning and function of all hardwired panel, MCC, and field mounted discrete operator interface monitoring and control devices. Correlate functions to the control strategies.

- D. The presentation and use of all elements of all OIT and SCADA HMI screens provided by the SUPPLIER for this project. Relate to control strategies. Include screen shots of all screens provided by the SUPPLIER with narrative descriptions of use, function, meaning, color conventions, animation, etc., of all screen elements.
- E. PLC, OIT, SCADA, remote alarm notification system, and process data historian tag data base lists.
- F. Configuration screens for all PLC, OIT, SCADA, historian, remote alarm notification, communications, and network system components.
- G. Network schema: Provide IP address listing
- H. System, application, data base, remote access, etc., security. Provide all configured user and administrator user names and passwords.
- I. System start up procedures for SCADA systems supplied and configured by the SUPPLIER for the project.
- J. The system users manual shall be completed prior to and shall be used for required training. The manual shall be updated to incorporate comments received during training and re submitted for inclusion in the O&M manual. Submit 2 weeks prior to training.
- K. Packaged equipment SUPPLIER shall supply user's manuals per the above requirements for the systems they supply.
- L. Third parties other than the packaged equipment SUPPLIER who provide PLC, OIT, SCADA, or other programming shall provide users manuals for the programming they provide.

3.11 Training

The CSI shall conduct specifically organized training sessions to educate and train the OWNER's personnel in the maintenance and operation of all aspects and components of the control system they supply. Training on all system components shall include, but not be limited to, the following subjects:

- A. All O&M manual items
- B. All system users' manual items

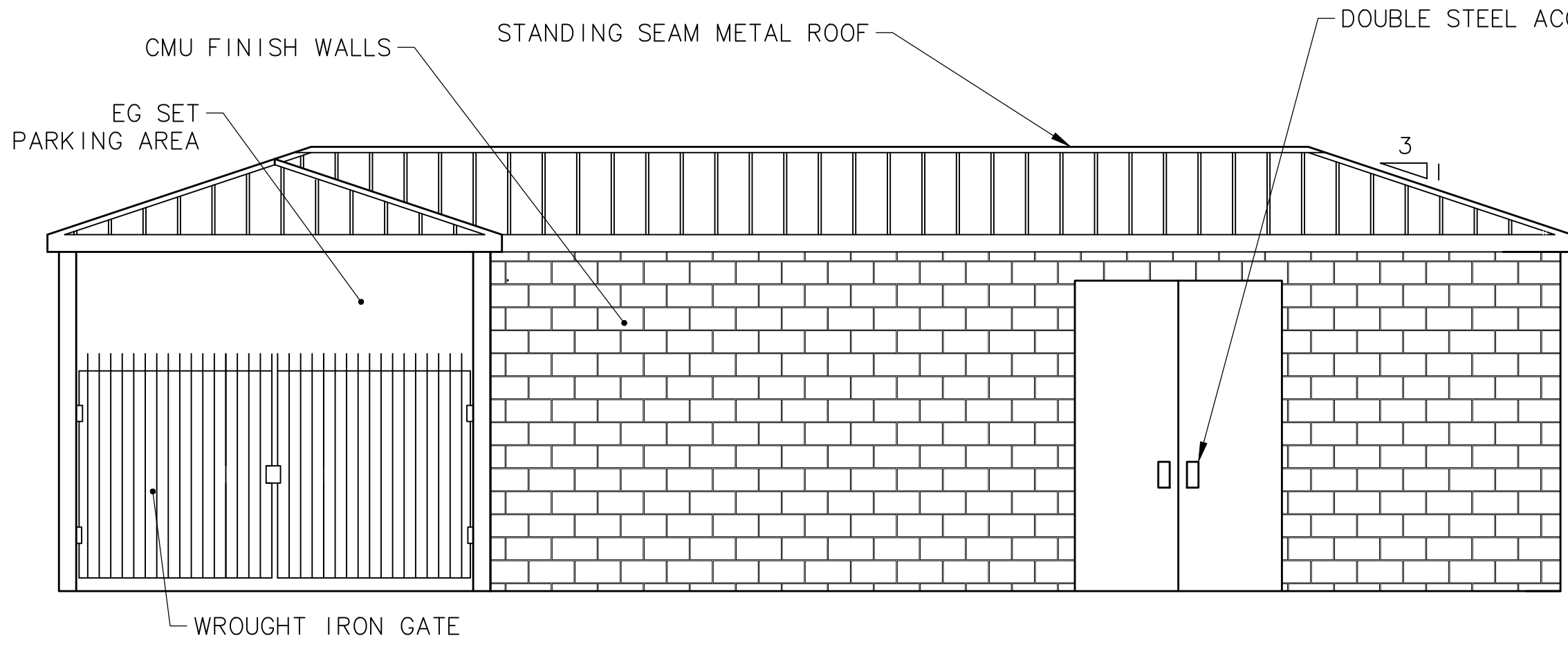
- C. The CSI shall provide a minimum of 16 hours of on-site instruction to the OWNER's employees after start-up and commissioning of the system. The OWNER shall be allowed to video tape all or any part of the training sessions. The CSI shall prepare and assemble specific instruction materials for each training session and shall supply such materials to the Project Representative at least two (2) weeks prior to the time of the training. The O&M manuals and the system users' manual shall be complete and shall be used in the training sessions.
- D. Training shall cover details of operation of VFD's from the HIM (Human Interface Module). Training shall provide detailed instructions on the modification of VFD operating parameters typically requiring adjustment by operators. The SUPPLIER shall develop and provide "cheat sheets" which provide step by step instructions required to accomplish the following:
 - 1. Copy VFD configuration to Human Machine Interface (HMI)
 - 2. Copy HMI configuration to VFD
 - 3. Switch between auto and manual modes
 - 4. Manually adjust speed
 - 5. Adjust minimum and maximum speed limits
 - 6. Adjust acceleration and deceleration ramp times
 - 7. Access parameters and fault codes

END OF SECTION

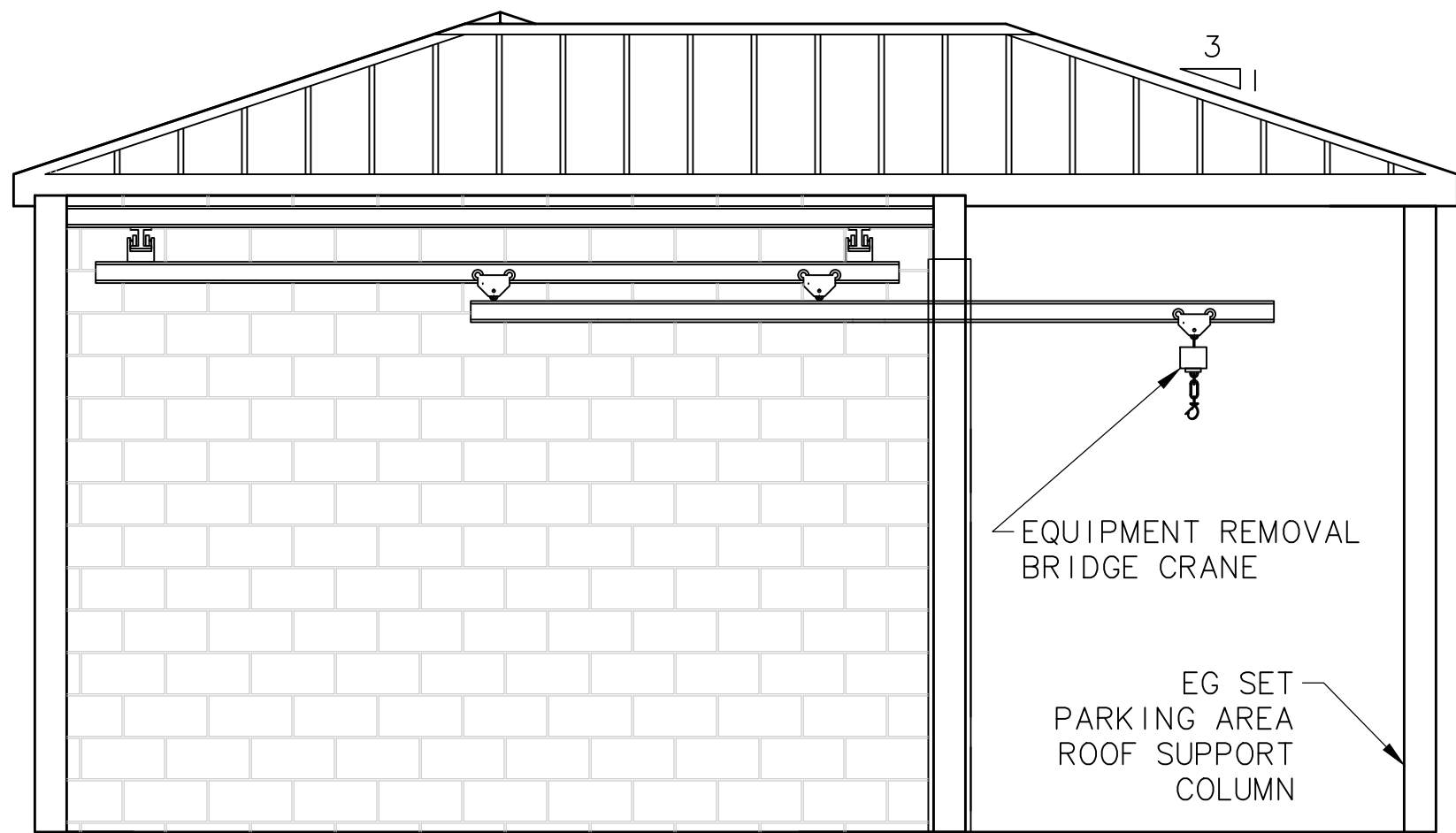


APPENDIX A PUMP STATION SCHEMATIC

K:\TAC_Projects\12\1388\CAD\Sheets\12-1388 DETAILS.dwg M-1 6/13/2013 10:58 AM MGM 18.2s (LMS Tech)



NORTH EXTERIOR ELEVATION
SCALE: 1/4"=1'-0"



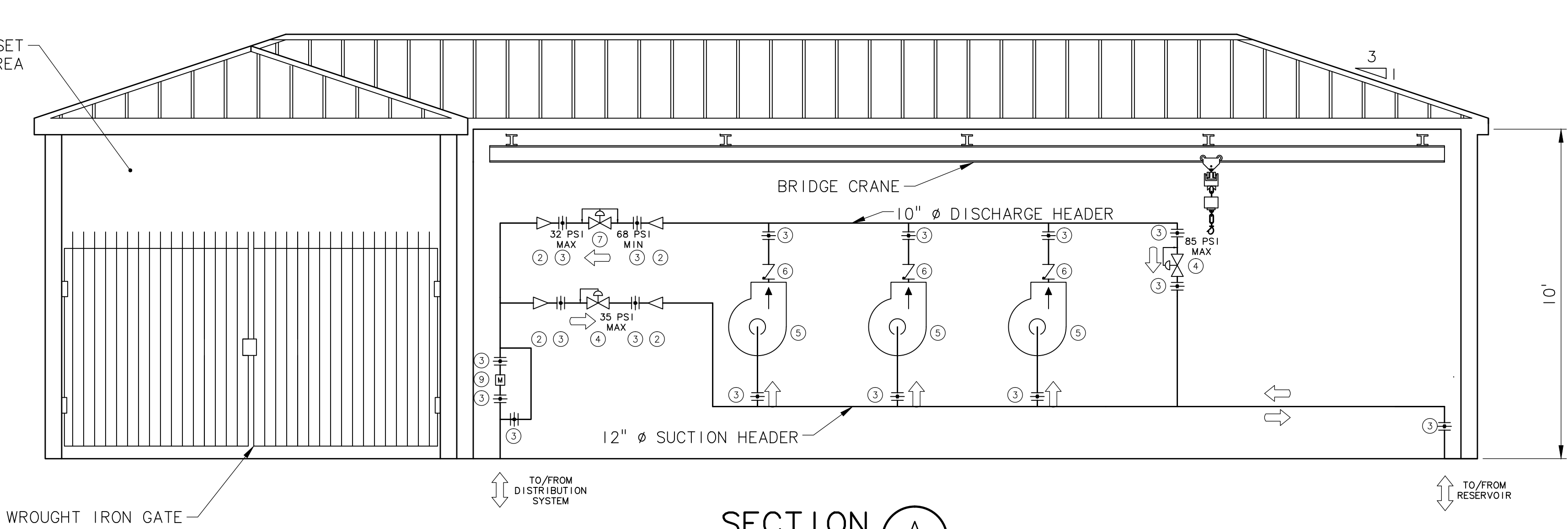
NOTE: MECHANICAL AND ELECTRICAL EQUIPMENT NOT SHOWN

SECTION B
SCALE: 3/8"=1'-0"

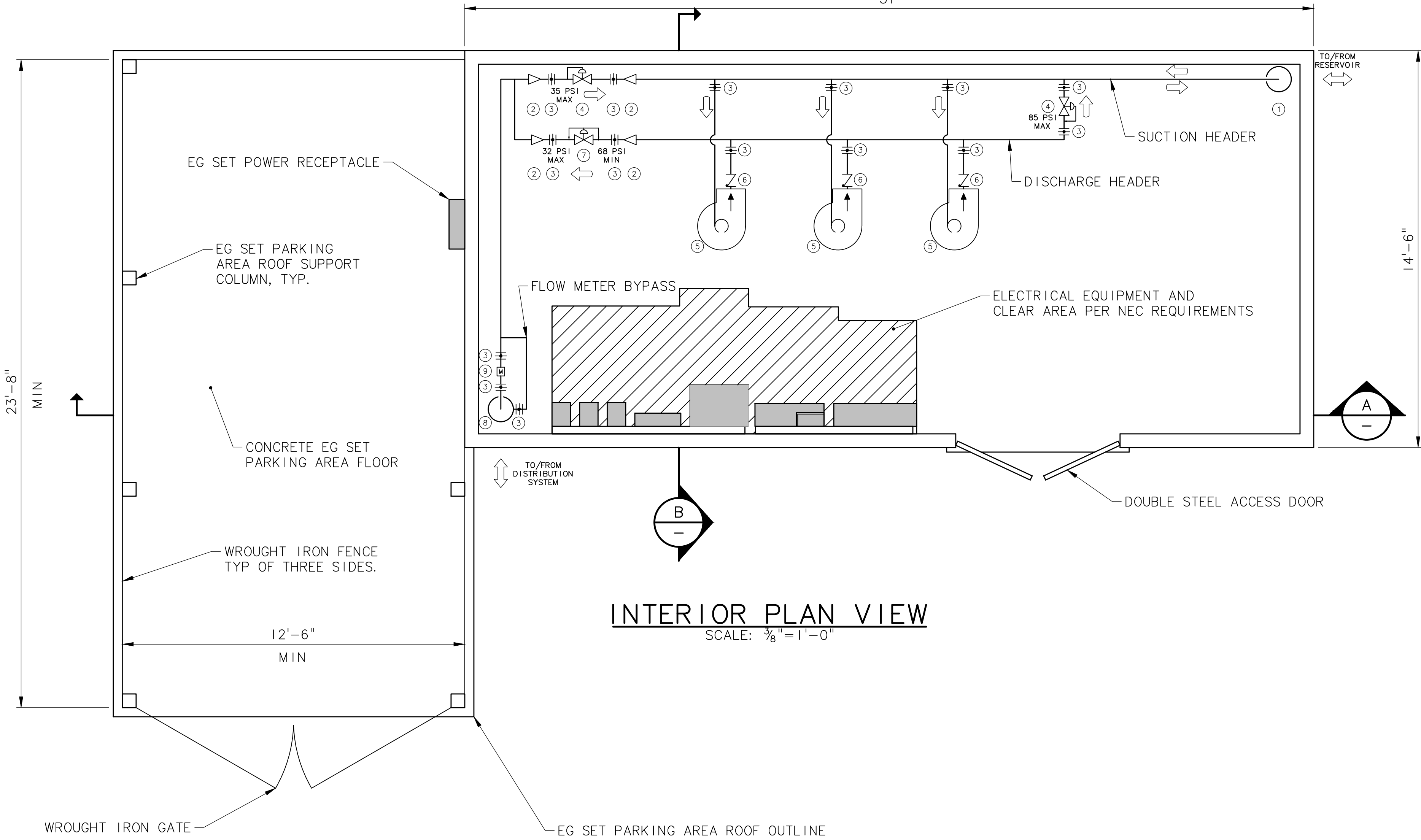
LEGEND			
1	PUMP STATION INTAKE, 12"	6	CHECK VALVE
2	REDUCER	7	COMBINATION PRESSURE SUSTAINING PRESSURE REDUCING VALVE
3	BUTTERFLY VALVE	8	PUMP STATION OUTLET, 12"
4	PRESSURE RELIEF, PRESSURE SUSTAINING VALVE WITH CHECK FEATURE	9	MAG METER
5	PUMP		

NOTES:
ALL EQUIPMENT ORIENTATION AND DIMENSIONS IS PROVIDED AS A STANDARD BASIS FOR BIDDING.
SUPPLIER TO PROVIDE DETAILED INFORMATION REGARDING ACTUAL DIMENSIONS AND EQUIPMENT PRIOR TO FABRICATION.

SIZE OF EG SET PARKING AREA SHALL BE ADEQUATE TO ALLOW FOR EG SET ENCLOSURE PANELS TO BE OPENED AND FOR EG SET TO BE OPERATED AND MAINTAINED WHILE EG SET IS PARKED INSIDE PARKING AREA



SECTION A
SCALE: 3/8"=1'-0"

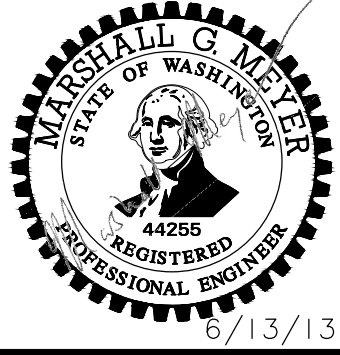


INTERIOR PLAN VIEW
SCALE: 3/8"=1'-0"

NO.	DATE	BY	REVISION

NOTICE
0 1/2 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE

MFP
DESIGNED
MGM
DRAWN
MGM
CHECKED



Murray Smith & Associates, Inc.
Engineers/Planners
1145 Broadway Plaza, Suite 1010 PHONE 253-627-1520
Tacoma, Washington 98402 FAX 253-627-1923



CITY OF SHELTON
ANGLESIDE RESERVOIR
BOOSTER PUMP STATION

PUMP STATION
MECHANICAL SCHEMATIC

PROJECT NO.: 12-1388.202 SCALE: AS SHOWN DATE: JUNE 2013

SHEET
M-1
1 of 1